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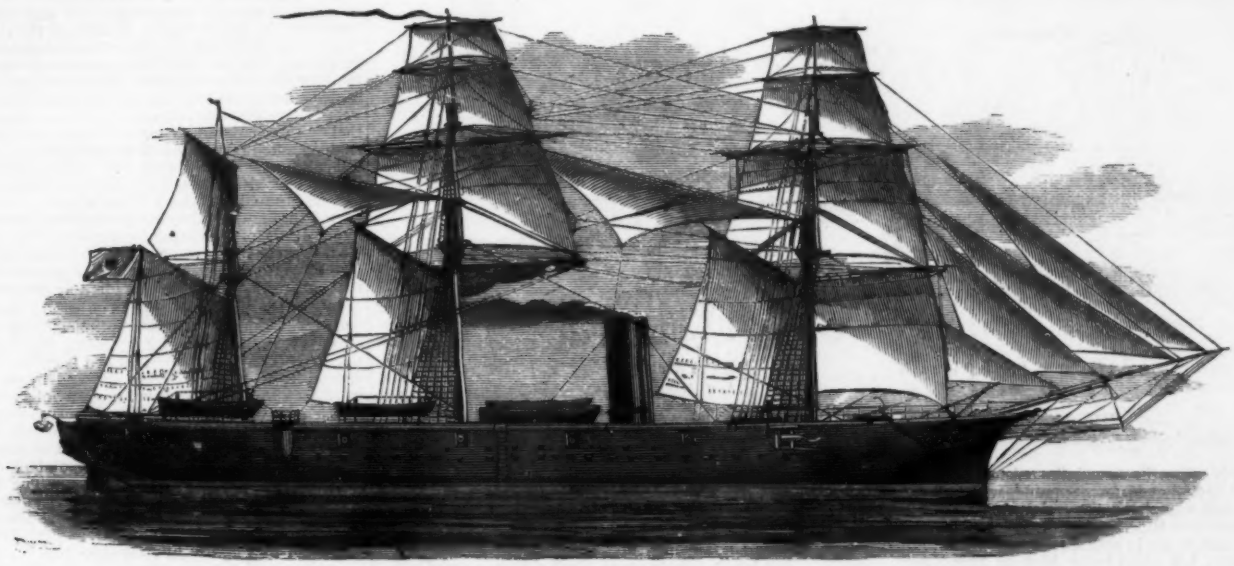
NEW WAR SHIPS FOR JAPAN.

THESE vessels are now approaching completion in England, and as they possess, in addition to the interest attaching to them as the first important vessels entrusted by the Japanese to English constructors, some noteworthy points of design, we propose to describe them at some length. The ships are three in number, and are named respectively the Foo-Sō, Kon-go, and Hi-Yei, the names of mountains in Japan. We take the Foo-Sō first in order as being the most important. She is a broadside ironclad vessel of somewhat similar type to those designed by Mr. Reed for the Chilian Government, and completed in this country about two years ago, and also somewhat similar to, but much more powerful than, the Fethi-Bulind and Mukademme Kies, two Turkish vessels also built from the designs of Mr. Reed, when he was Chief-Constructor of the Navy, and which have performed excellent service during the present war. The Foo-Sō, although but little larger, has been made much more formidable than the Turkish ironclads referred to, by means which the later date of her design has rendered practicable. She has, in addition to the main deck battery, an upper deck battery carrying two guns of 17 centimetres bore with fire right forward and aft, and commanding the whole horizon, and her armor is attached to the hull in a novel manner, which is described further on. Subjoined will be found the profile of the Foo-so, while Figs. 3 and 4 show the upper and main deck plans. The following are her principal particulars:

		ft.	in.
Length between perpendiculars		220	0
Breath, extreme		48	0
Depth in hold		20	4½
Draught of water	Forward	17	9
	Aft	18	3
Hight of port from low-water line		8	6
Displacement in tons		3718	
Indicated horse power		3500	
Speed in knots		13	
Complement of men and officers		250	
Armament	Main deck battery four 24 centimetre guns.		
	Upper deck battery two 17 centimetre guns to fire forward and aft.		

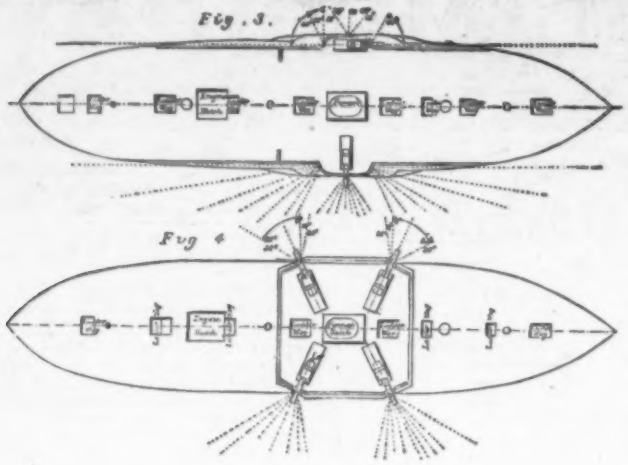
The vessel is armed with Krupp guns of the dimensions stated above, and it will be seen that they are disposed on the central battery system, the armor on the sides of the battery being 9 in. thick and on the athwartship bulkheads 8 in.; access to the battery from the fore and aft parts of the main deck being by means of armored doors. The guns on the main deck, four in number, have a weight of about 15½ tons each, and, being fitted on the embrasure plan, command the broadside, and within 30° of the fore and aft line; the guns on the upper deck weigh about 5½ tons each and command, as already said the whole horizon, must be of great value as chase guns and for various other purposes.

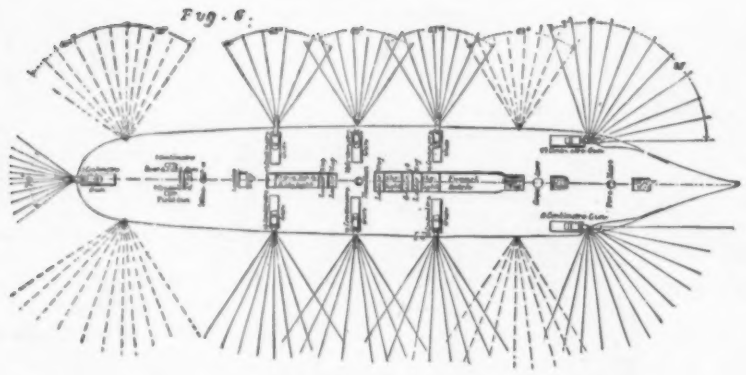
The machinery of the Foo-So consists of two pairs of compound horizontal surface condensing trunk engines by Messrs. Penn, driving twin screws 15 ft. 6 in. diameter. The boilers are eight in number of the cylindrical type, working at 60 lbs. pressure; each is 11 ft. 3 in. in diameter, and contains three furnaces, each 2 ft. 11 in. in diameter. On page 374 will be found a section, Fig. 5, through the side of the vessel, showing the method of attaching the armor to the hull; it will be noticed that the armor is supported by brackets attached outside the frame of the ship, thus allowing a clear line from floor to deck for the frame, and avoiding all the expensive and often unsatisfactory work of the armor shelf as hitherto constructed. The projecting edge of the armor will further act as a bilge-keel to reduce the rolling. The iron floating batteries built for the Crimean War were similarly constructed, but this is the first instance in which Mr. Reed or any constructor has applied this improvement to sea-going ships; and it appears to have the advantages of cheapness and expedition in building, especially as the bending of the armor plates to the vertical curvature of the ship is in this case avoided. That the first



IMPERIAL JAPANESE CORVETTES "KON-GO" AND HI-YEI," DESIGNED BY MR. E. J. REED, F. R. S. FIG. 2.

IMPERIAL JAPANESE IRONCLAD "FOO-SO," DESIGNED BY MR. E. J. REED, F. R S. FIG. 1.





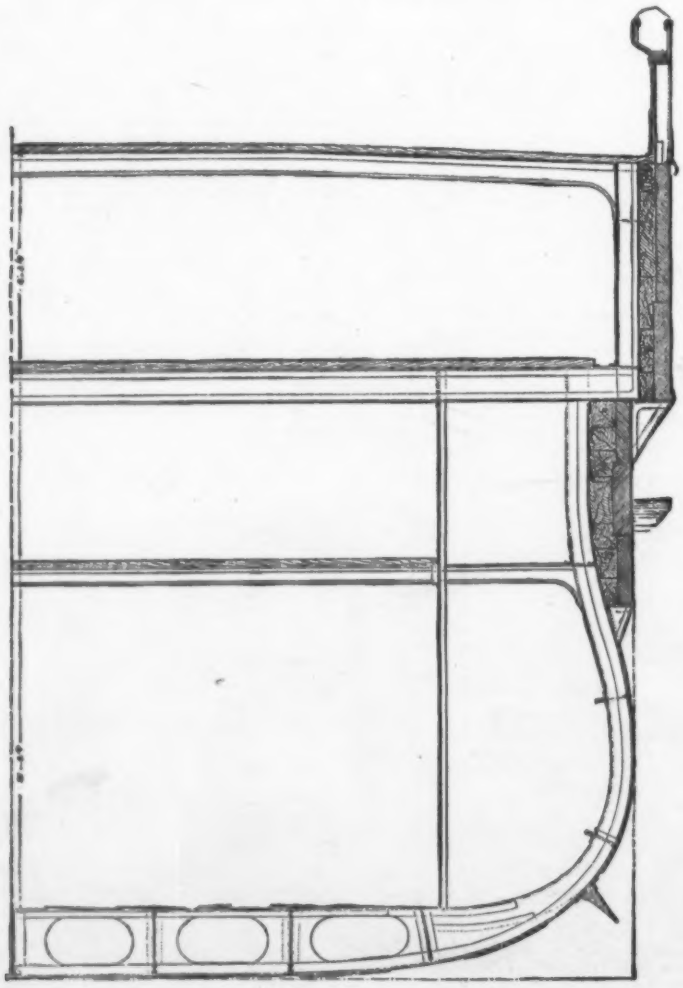
THE NEW JAPANESE WAR SHIPS.

advantage exists is self-evident, and the existence of the last is proved by the fact that Messrs. Samuda, with whom the contract was placed, completed the framing and plating of the vessel in a very short time. The Foo-So is barque-rigged and is extremely handsome in appearance; she will no doubt be very handy also, her speed being high in proportion to her size, and her length being little more than 4½ times her beam.

The Kon-go and Hi Yei are sister vessels, the Kon-go being built by Earles' Shipbuilding and Engineering Company, of Hull, and the Hi-Yei by the Milford Haven Shipbuilding and Engineering Company, Pembroke Dock; the engines for both these ships being supplied by the first-named company. The leading features of the light unarmored composite corvettes of the Gem class lately introduced to the British Navy are now well known, and it was thought desirable to supply the Japanese Navy with two vessels of this general type, but some very material modifications and improvements obtained by means of some increase of size. The vessels for Her Majesty's Navy are in the latter examples 220 ft. long, 40 ft. beam and about 17 ft. 6 in. draught, armed with fourteen 64 pounder (64 cwt.) guns on the upper deck, capable of firing 2° across the bow line forward and 2° across the central line aft; they have a speed of about 13 to 13½ knots, horizontal compound engines of 2,100 indicated horse power, a large spread of canvas, steer well, and are very handsome. They, have, however, no protection above the water line for their machinery, excepting such as is afforded by the stowage of coal in the wing bunkers; this protection, however, is not of a permanent character and is liable to disappear after the vessel has been some time at sea. The weight of coal carried is about 240 tons. The Japanese vessels are 231 ft. long, 40 ft. 9 in. beam, and 17 ft. 6 in. draught, armed with six 15 centimetre (about 4 tons) Krupp guns on the broadside, two guns of 17 centimetres bore (about 5½ tons) at the bow, capable of firing either right ahead or 32° abaft the beam, and one 17 centimetre gun at the stern, capable of a range from right astern to 35° forward of the beam. They have horizontal compound engines of 2,500 indicated horse power, and have also a large spread of canvas; indeed the rig of all the three Japanese vessels has been made as nearly as possible the same, in order to make any of the spare spars, rigging, or stores available for either ship. The corvettes each carry about 280 tons of coal. In order to secure the power of fighting the gun right aft, Mr. Reed has not adopted the poop and the apparatus for lifting the screw from the water fitted to the British ships. In the case of the latter the guns can fire only within an angle of about 2° across the fore and aft line except by removing the gun from side to side of the ship. The abolition of the screw lifting gear will undoubtedly simplify the arrangement of the machinery astern, and disconnecting gear to allow the free revolution of the screw when the vessel is under sail is provided. On one important point the Japanese vessels have great advantage, that is as regards boiler space; their greater length as compared with the British ships has enabled much larger boilers to be fitted, and, as much of the difficulty experienced with the machinery of the Tourmaline and her sister vessels appears to have sprung from priming, owing to insufficient steam space, it is confidently expected that much more satisfactory results will be developed in the trials of the Japanese vessels. The speed expected from them is 13½ knots, but judging from the beautiful lines of the vessels and their large engine power it is not unlikely that this estimate will be considerably exceeded.

One of the most important features of the Japanese corvettes yet remains to be mentioned, and that is a belt of armor 4½ in. thick extending along the ship at about the height of the water line; this belt is embedded in the wood sheathing of the ship, being covered by an outer thickness of plank 3 in. thick, thus avoiding any obstruction to sheathing the vessels with copper in the usual way. In addition to the armor protection there is also that afforded by the coals which surround the magazines and boilers, but, as we have said, this latter protection cannot be depended upon in the later stages of the vessel's cruise. The Kon-go and Hi-Yei are certainly in appearance the handsomest vessels intended for war purposes which we have ever seen; they are more like yachts than men-of-war, and this fact may be taken as a proof that fighting power does not in all cases involve the ugliness of which so many naval critics have complained. We hope to fully report the trials of all three vessels at an early date.

We have spoken in this article of two classes of war vessels; it yet remains to allude to a third class. Small gunboats carrying powerful guns have undoubtedly a place in a well organized fleet; and as several of them are now in the possession of the Chinese Government, a comparison of their qualities with those of the vessels above described—if powerful cruising ships may for a moment be compared with mere gunboats—may not be out of place. The latest examples of these gunboats supplied to China are, we believe, the Gamma and Delta vessels, having a displacement of about 430 tons on a draught of 8 ft., length being 115 ft., beam 30 ft., and freeboard 3 ft. Each vessel can carry 50 tons of coal in her bunkers, and is fitted with two tripod masts. The boats are each armed with a 38-ton gun, and with two 12-pounder breechloaders at the stern, the screw being protected forward from rifle fire by a shot-proof shield; this, however, with the exception of the coal-bunkers and water-tight compartments, is the only protection the vessel possesses against the enemy's fire, although the boilers are, we believe, in some parts above the load water-line, and, therefore, much exposed. The speed of these little vessels is nine knots. They are reported to have made a safe and favorable passage out *via* the Suez Canal, but it must not be inferred from this, as has been hastily done in some quarters, that they have thereby proved themselves to possess the properties of sea-going vessels, and to be qualified for operating against ordinary ships of war under the various requirements of naval warfare. In going out to China all that has to be done is to get from port to port at chosen times; and to carry, when commencing each stage of the voyage, a sufficient bulk and weight of fuel and provisions for the length of time that a straight run over might be expected to last. It was a great feat for such small boats to do this as they did, but their doing it has not of course shown them to have any value as fighting ships capable of keeping the sea and performing the many various duties of sea-going men-of-war, at all times and in all weathers. They are doubtless valuable for defending rivers or shallow waters, where they can at any time retire into a depth of water too small for any powerful sea-going ships to follow them, or into a port for supplies; but they have neither the carrying power, speed, height out of water, or steadiness of gun platform that would enable them to go to any great distance to meet an enemy and fight at sea, or to keep the sea successfully for any time except in fair weather. Their chief means of defence lies in the shallowness of their draught; if hard pressed, they can avail themselves of this, and escape easily by retiring into shallow water; their draught has in this respect been rightly regarded as their great merit, and as a very effective means of safety, but if they proceed to sea with no path protected by which they may easily retreat into shallow waters, the only means of defence they have will be gone, and they will be at the mercy of any ordinary modern war vessels, which will have the choice of attacking them at once or waiting a more favorable opportunity. The lowness of their speed—a maximum of nine knots under the most favorable conditions—will make it impossible for them to force an action at sea if they wish to do, or to avoid one in the event of bad weather or any other circumstance arising which, while placing them *hors de combat*, would leave an enemy with efficient sea-going vessels perfectly able to fight.



THE NEW JAPANESE WAR SHIPS.—FIG. 5, MIDSHIP SECTION.

It is true that the one gun which each boat carries is a very powerful one, but, on the other hand, it is floated in a hull which even boat's guns are sufficient to destroy, so that the mere boats of such vessels as Foo-So and Kon-go would be equal at times to the destruction of these gunboats. The fact that the single gun of these Chinese gunboats is without any power of lateral training would greatly facilitate their destruction by the lightly-armed boats of sea-going ships. No doubt a great deal of offensive power exists in these gunboats, and everything cannot be done in vessels of such small size; still the fact that the guns are without training would under some circumstances, such, for example, as an injury to the exposed propelling machinery, cause these vessels to fall an easy prey to other boats. Moreover, those who know what river service with gunboats in war time is, will not need to be told how often they get aground, even under the most skillful management, especially in tidal rivers and under fire; and when once aground any other boat, though herself aground, would destroy these Chinese boats with the greatest ease by means of their light guns that can fire in any direction. The idea of such boats being qualified for general warfare at sea, or at any distance from a friendly port, is an illusion, and will not bear examination. Their small size only enables them to carry a very limited supply of coal and provisions, and so fixes very narrow limits to the distances they could safely proceed at sea and incur the risk of bad weather arising, in which they could not fight, or of their retreat being cut off by the enemy. Their low speed makes them helpless to fight at sea, except when it best suits the enemy they should do so; their low freeboard of only 3 ft. makes them unable to fight in seas in which the enemy with ships having ports of the necessary height out of water could easily take advantage of their helpless condition and destroy them; while their form and proportion and arrangement of weight is such as to give rise to comparatively quick and uneasy rolling, doubtless causing the firing to be very uncertain and ineffective (even under those favorable conditions of weather which would enable the gun to be fired), as compared with the practice that is made in modern war ships of larger size. These boats can only fight in comparatively smooth water, and within easy reach of shallow water to retreat upon for the purpose of defence; and it is idle to imagine they can ever be effective at sea. They will be valuable for defending rivers and ports and coast lines of a certain character, although even for this they possess, as we have seen, one serious defeat, which is that, if running into shallow water, they go too far and get aground, or get left aground by the tide leaving them, they will not be able to train their large guns. These guns cannot be moved about in the boat, and in such cases, therefore, the gunboat would be subjected to the enemy's fire without being able to reply to it except in one direction, which could of course be easily avoided. These small vessels have their uses and advantages and are very valuable in their place, but they are constructed exclusively for certain uses, and are very ill-adapted for any other. The nation that possesses a number of them has a valuable element of defence, but it has not on that account any offensive naval power, or any adequate means of protecting its interests at sea. Aspiring, as they justly do, to real maritime power, both offensive and defensive, the Japanese Government appear to have taken a wise course in building substantial and efficient sea-going ships.—*Engineering.*

HOW TO BUILD CATAMARANS.

By PADDLEFAST.

IN the following are full particulars and dimensions how to build a fast, safe, and cheap boat, of the plainest make, or a lighter and more elegant one, as desired, from 25 to 30 feet in length. Technical skill is not necessary, as there is no bending of ribs nor fitting of planks.

A 25FT. PLAIN CATAMARAN.

The only successful principles in the construction of the catamaran are extremely sharp hulls, and all possible lightness. Hence it is not surprising that a length less than 25 feet is not advisable for these boats, and that the catamaran about to be described will not carry more than two passengers, without detriment to speed and safety. The speed of this boat, under favorable circumstances, is about 14 miles per hour. The approximate cost of materials is $60. This boat can be used to advantage only in well protected waters.

The two hulls are precisely alike, and much time will be saved by duplicating every stick and board as it enters the hull first built, and laying them systematically away for the construction of the other.

The entire craft is constructed of pine, except the "aprons."

The keel of each hull is of the rocker kind, *i. e.*, curving upward at each end, like the bottom of a surf boat. Placing the keel, about 25 feet long, 2 inches thick, and 5½ inches deep, in proper position, with an upward curvature of 1 foot, we set uprights at both ends, to temporarily represent stem and stern, which are both to be near the vertical. Next, a pair of thin strips, or combination of strips, are tacked to bow and stern and made to describe the curves of the hulls shown in Fig. 4. There are to be 17 frames in the boat, about 16 inches apart. The curve of the strips should be regulated, so that the deadflat, or widest part, is at the seventh frame from the bow. This should also be the lowest point of the keel. The beam between the strips at deadflat is 36 inches. The vertical height from bottom to keel at deadflat to upper edges of strips should be 35 inches. At about a yard from both ends of the boat, the strips may be slightly pressed apart to make a better curve. The sheer given to the strips should not be more than 4 inches.

Fig. 1 gives the deadflat section of the boat. The ribs B are perfectly straight, and are nailed directly to the

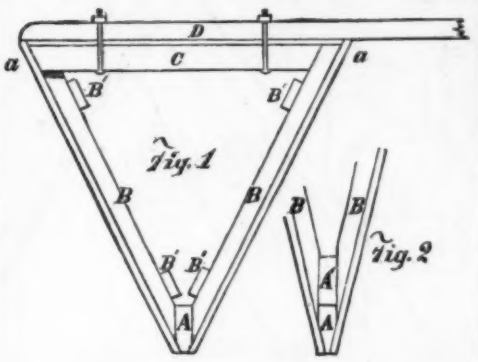


Fig. 1. Fig. 2.

keel A, one a little forward of the other, so that one rib is secured against the aft side of the deckbeam C, and the other rib on the forward side.

Now, by placing a stick in the position of B, the lower end against the keel, the upper end against the gunwale strips, and shifting this stick both forward and aft, we can mark out just how much is to be beveled off the lower edges of the keel. By the aid of the strips it will not be difficult to determine the shapes of all the bow and stern pieces, which will be put together as previously described in SUPPLEMENT 30. Fig. 2 shows a section of the boat near bow or stern, wherein the keel fails to afford sufficient nailing room for the ribs B. In this case, however, the bow or stern deadwood, A', is extended to nearly a third of the boat's length to afford a good backing for the ribs.

The temporary framework may now be taken down, the lower edges of the keel properly planed off, and the bow and stern pieces shaped. From this point the builder has no difficulty in replacing the keel in position, setting up bow and stern pieces, which are very much alike, consisting of stem or stern piece, apron (of oak), and deadwood—constructing the deadflat frame, Fig. 1, and the other frames in turn being guided, as before, by the gunwale strips. As the frames are made they are connected by the diagonal braces B', Figs. 1 and 3, the latter being a side-view of boat, the vertical lines representing the frames.

Those deckbeams C, to which the crossbeams D are to be bolted, should be about 1¼ x 3 in., the other deckbeams may be 1 x 3, or less. The ribs A should be 1 x 2 in.

After nailing on the deck, composed of ⅝ inch strips, 2 inches wide, and inserting the bolts intended to secure the hull to the crossbeam D, Fig. 1, the boat is planked up outside with ¾ stuff, caulked and pointed. It must not be forgotten to provide a hatch in each deck, as is shown in Fig. 4, large enough to bale from.

The hulls, when thus far completed, are set perfectly parallel, 11 feet apart from keel to keel. Then to frames 1, 7, 8, 10, and 13, counting from the bows, where the bolts have already been provided, are bolted the five crossbeams D, 2 x 6 in., shown in Fig. 4. On the crossbeams are set edgewise the diagonal pieces E, 1¼ x 6 or 2 x 5 in., with end piece E' extending from hull to hull. The space thus enclosed is floored over with ⅛ in. matched stuff, after securing the supplementary floor beams F, 2 x 2 in., to the pieces E.

The mast G is stepped midway between the second and third crossbeams, and surrounded by three heavy blocks about 8 inches high, which enclose the end of bowsprit also. The port and starboard blocks are connected by two horizontal bolts, one abaft the mast, passing through the end block there, and one forward of the mast, crossing just over the bowsprit. The two side blocks are bolted to the crossbeams beneath, also. The bowsprit H is secured to the first crossbeam by the iron strap H'. The bobstays I are attached to the cutwaters at the water line. The mast is supported wholly by the jib-stay and the shrouds I'. The shrouds are carried well back to obtain a firm spread, consequently they are attached to the hulls by blocks and running lines operated from the deck, so that either shroud may be loosed when necessary, to afford sufficient swing to the boom.

The tiller J is about 3½ feet long forward of the pivot, and about twenty inches aft the pivot. The port rudder is several inches higher than the deck, to afford nailing room for the lever L. There is the usual traveler on the stern piece E', with double blocks, as shown.

The best jib is that used on the "John Gilpin" and the "Tarantella," SUPPLEMENT No. 105. The jib-boom projects about 18 inches beyond the end of the bowsprit, to which it is attached by a swivel.

The jib-stay runs to the end of the boom, but is quite independent of the jib. The jib, instead of sliding up the stay with hoops, is simply hoisted by the halyard with double blocks, and hauled taut.

The end of the peak halyard is attached to the gaff well up toward the peak; the halyard is then run through a double block at the mast head, then through a single block on the gaff, again through the double masthead block, thence to the deck.

The stays and shrouds should be wire rope ¼ in. diameter. The anchor should weigh 30 lbs.

The mast should be tapered considerably from the middle downward.

The foot needs but very little more diameter than the head.

We will again run over the principal

Dimensions.

Length of hulls over all	25	ft.
Beam " " on deck	3	"
Draft " "	17	in.
Height " " out of water, at X	18	"
Distance " " apart, center to center	11	ft.
Length of boom	23	"
" " bowsprit	16 ft. 9	in.
" " jib-boom	18	ft.
Hoist of mainsail	16	"
Diameter of mast and main boom	5½	in.
" " bowsprit	5	"

A 30 FT. CATAMARAN.

The deck of the previous boat is but 18 inches above the surface of the water, and besides a great bulk of hulls is exposed to the action of the sea; consequently it would hardly do for bay sailing. The boat that we have now to do with is intended to be safe, fast, and serviceable in almost any waters, and the combination of simplicity and lightness in construction is unequalled.

This boat, like the previous, is not expected to carry a much greater weight than two persons. The maximum speed will, doubtless, be 18 miles per hour, as that rate has been reached by the "Amaryllis," a catamaran 5 feet shorter, but of lighter construction.

The cost of materials, including sail cloth and rigging, will be about $80.

The hulls are made just as before, save that the length over all is to be 30 feet, and the height out of water, 12 inches, instead of 18 inches, or, in other words, the vertical depth at the deadflat frame, from the upper edge of the deck-beam to the lower edge of the keel, is 29 inches. The beam on deck is thus reduced to 30 inches. The frames are still 16 inches apart.

As our isometrical scale drawing, Fig. 4, shows, the boat consists of two low hulls connected by crossbeams at intervals, and a passenger deck or car swung midway between the hulls at a higher level than the decks of the latter. This car consists mainly of the sides E, 1½ in. x 6 in., to which the ⅜ in. flooring is nailed. The flooring is strengthened by the middle piece F, beneath, 1¼ x 6 in. The car is supported at the stern end by the vertical pieces E', which rest upon the rearmost crossbeam. Fig. 9 shows a good method of bolting E' to the crossbeam. The car at the bow end hangs from the junction of the pieces L, which serve somewhat the purpose of shears. As Fig. 7 represents, the shear-pieces L are attached to the rear end of the bowsprit H, by a joint that allows free vertical play. The bowsprit is squared for about 4 inches at the end, and bound by two iron straps carrying rings to which the pieces L are hinged. The forward of these two straps also binds the pendant piece R securely to the bowsprit. This latter is firmly nailed to the end piece of the car on the outside, and a narrow portion of R continues down and is secured to the middle piece F, as Fig. 6 shows.

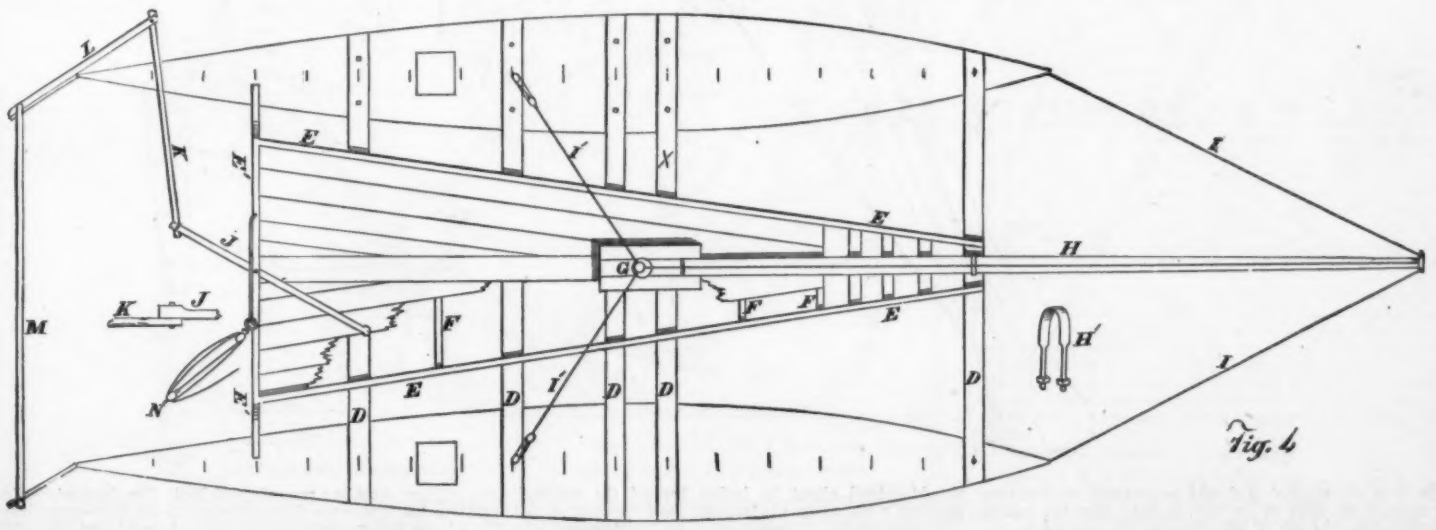


Fig. 4.

THE CATAMARAN OR DOUBLE HULLED SAIL BOAT.

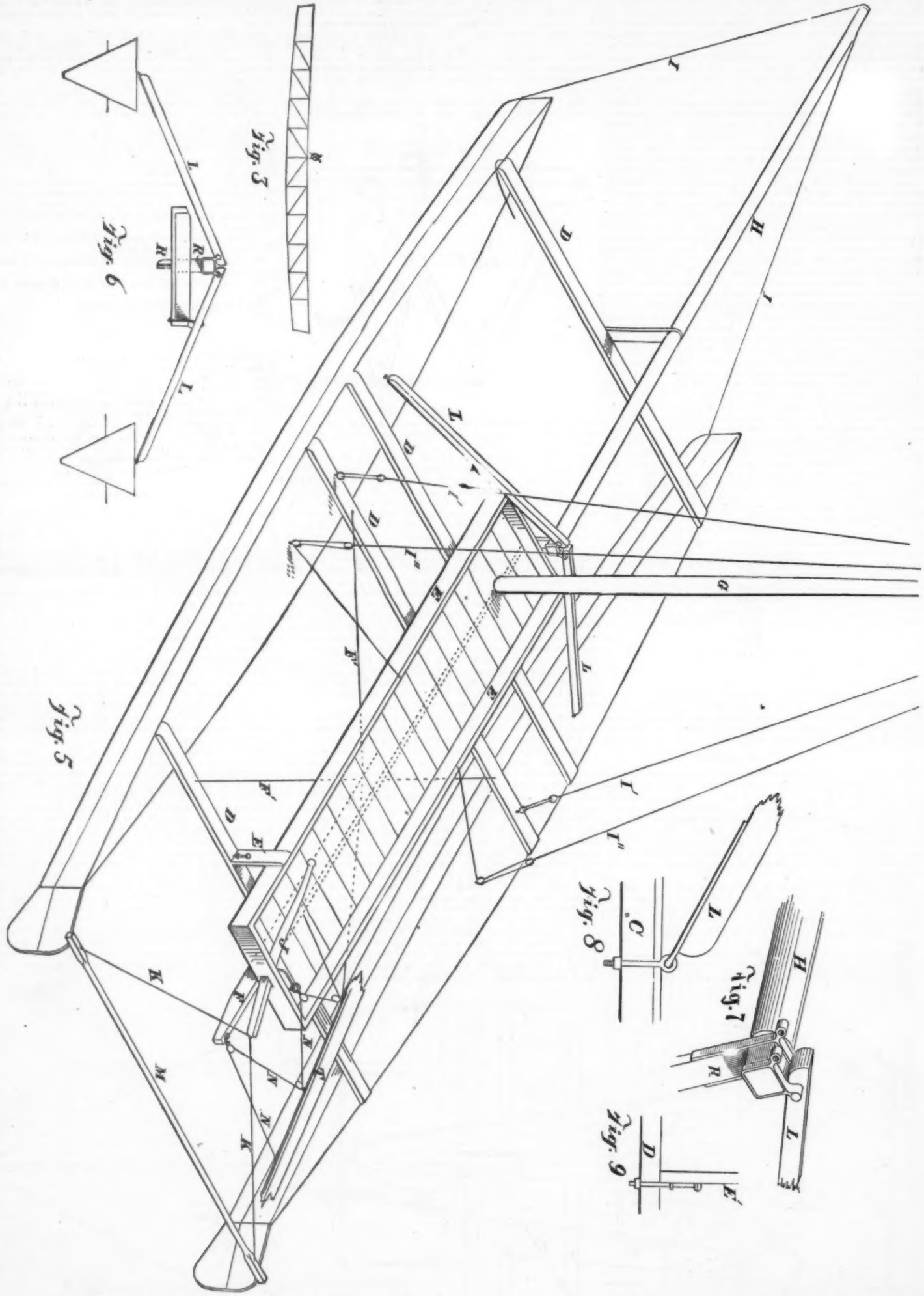
To prevent oscillation, the car is secured to one of the shear pieces L by a bent bolt, also represented in Fig. 6; and the space that occurs between the upper edge of the side of the car and the under side of L is firmly blocked up. The shears L are attached to the deck beams of the hulls, by the strap and bolt shown in Fig. 8.

As the backstays I″ are occasionally required to be loosed to give the boom sufficient latitude, they are attached to the hulls by blocks and running lines operated from the car.

A portion of the boom is shown at T, and the sheet N is run through a block on the rear end of the middle F, which should extend about 28 inches beyond the car, and also through a block on the traveler upon the rear of the car. The suggestions previously given on tapering mast, the jib, and the rigging of the peak halyard, apply here as well. The helm J should be about 4 feet long forward of its pivot, and from 18 to 20 inches abaft. The rudders are carried to 8 or 9 inches below the keel and are about 2 feet long.

The diagonal stays F′ are attached to the middle piece F and to the last two crossbeams. These, and the other stays ⅜ and shrouds I, I′, I″, F, K, should be ⅜ inch wire rope.

THE CATAMARAN OR DOUBLE-HULLED SAIL BOAT.—BY PADDLEFAST.



The butt of the mast G should be grooved, so that, passing through the floor of the car, it sets over the middle piece F. The shrouds I′ are permanently secured in any convenient manner to strong rings or staples in the decks.

There must be a pump in each hull. The cheapest construction is a square wooden tube about 2½ inches square inside; a loose-fitting plunger of oak, with a ¾ inch hole in the center, covered by a leather flap attached by a brass or copper screw; a wooden rod attached to the plunger by an iron fork.

The first crossbeam D is bolted to the second frame from the bow. The shears L come over the eighth frame from the bow; the second crossbeam D over the ninth-frame; the deadflat and the mast also are at the ninth frame. The third crossbeam comes over the eleventh frame; the backstay I" is attached to the thirteenth frame, and the fourth crossbeam is at the nineteenth frame. The car overhangs the fourth crossbeam by about 2 feet 6 inches.

When cruising, the sail may be furled at night, the boom supported at convenient height by the throat halyard and a crutch, and a piece of canvas thrown over the boom and attached to the sides of the car, making a snug tent.

Dimensions.

Length of hulls over all	30 ft.
Beam " " on deck	30 in.
Depth " " at deadflat	29 "
Draft " "	17 "
Sheer or rise of keel	12 "
Frames apart	16 "
Beam from center to center of hulls	13 ft.
Shear pieces L	3 x 3 in.
Crossbeams D	2 x 6 "
Middle piece F	1½ x 6 "
Side pieces E of car	1½ x 6 "
Diameter of bowsprit	5¼ "
" " mast and beam	5⅝ "
Length of bowsprit	21 ft 6 in.
" " boom	30 " 4 "
Hoist of mainsail	19 " 3 "
Weight of anchor	34 lbs.

A BETTER FORM OF CATAMARAN

may be built by attaching the deckbeams, car, etc., of the preceding boat to full-modeled hulls, *i. e.*, hulls of curved cross-section, thereby obtaining a handsomer and faster boat. This involves an increase in cost of materials of about $15. The principal dimensions would be the same.

The best form of section of hulls for speed has been determined by numerous experiments, and persons desirous of building a full-modeled catamaran may obtain a "body plan" from the writer at reasonable price.

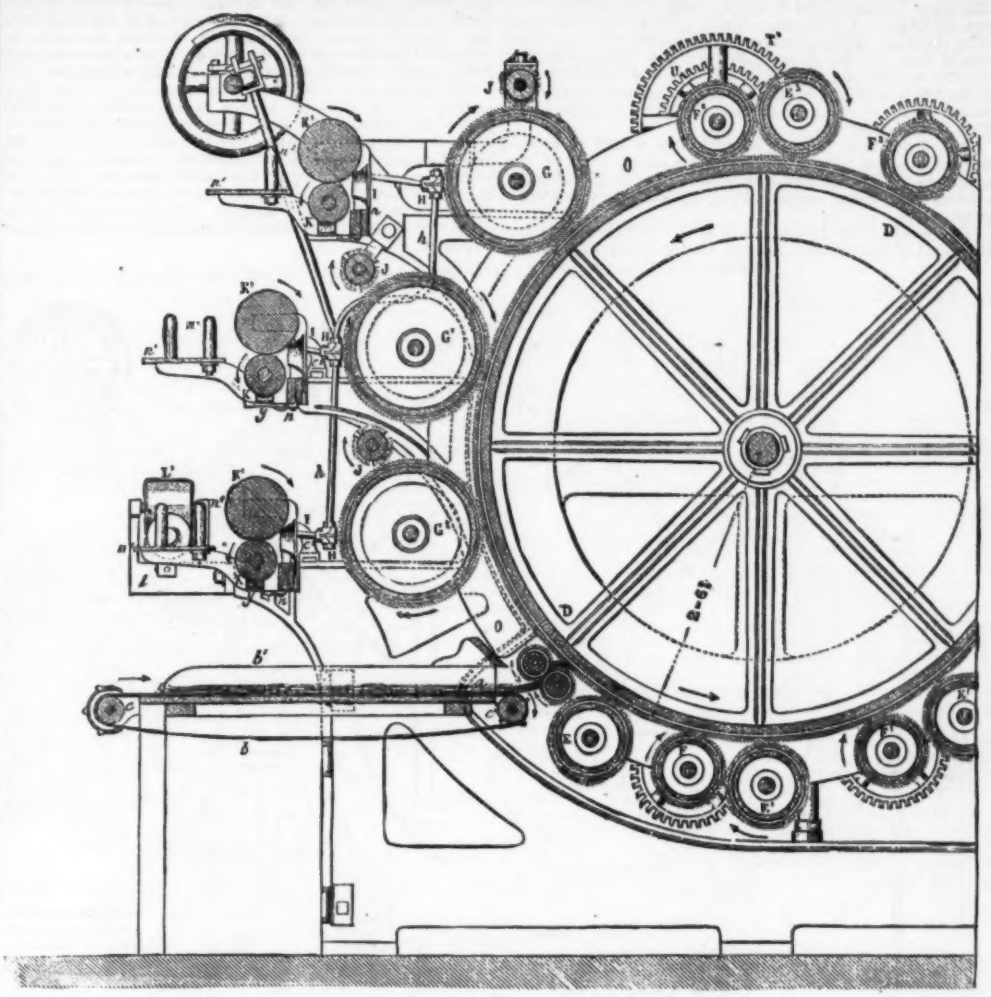
TOW AND JUTE CARDING ENGINE.

CARDING engines are always described in English feet; thus, we designate ours 5 × 6—that is to say, the drum is five feet in diameter and six feet long. The width of the tables corresponds with the length of the drum, there being three of these, each two feet wide.

On this and succeeding pages will be found views which indicate very clearly the arrangement of the machine, the

Fig 3

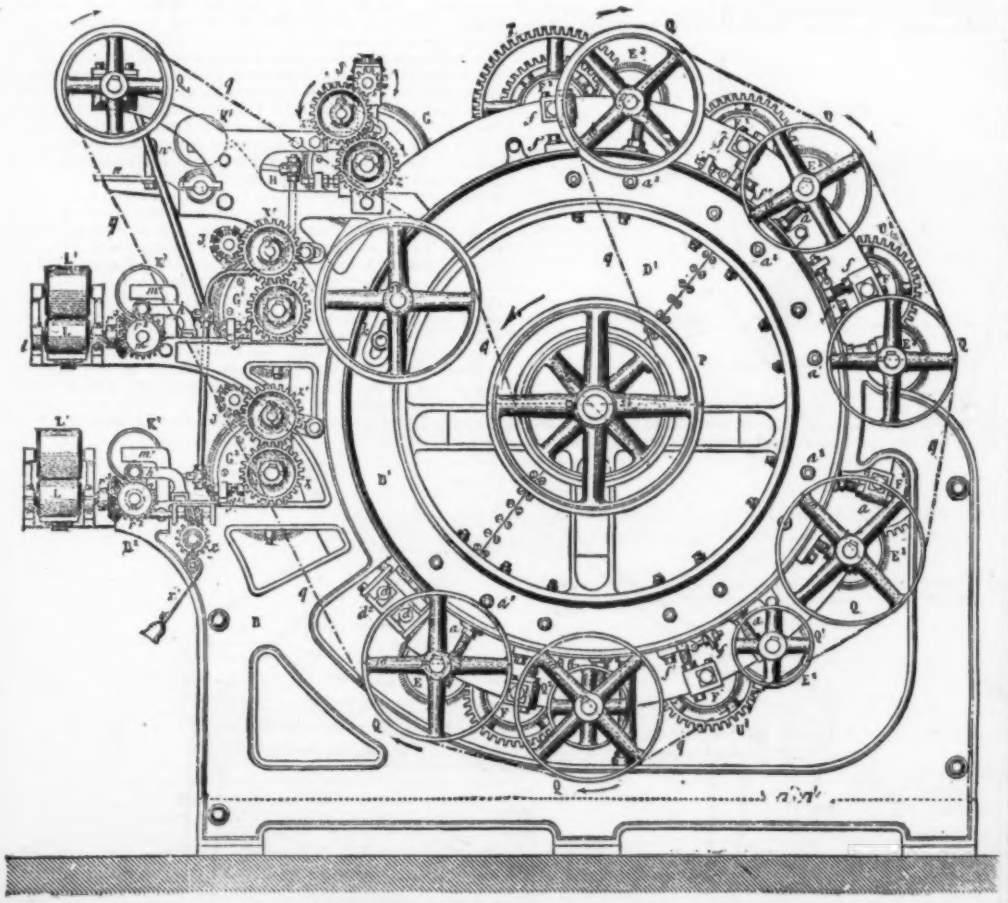
action of which we are considering. Fig. 1 is an elevation on one side showing the driving pulleys, the diameters of which in inches are shown by the figures on each. Fig. 3 is an elevation on the other side, representing the toothed gearing for actuating the various parts, the number of teeth in each wheel being indicated by the figures contiguous to each, and Fig. 2 is a section up the center, showing particularly the feeding apron, and the relative positions of the rollers, cylinders, etc.



TOW AND JUTE CARDING ENGINE.—FIG. 2.

The third doffer is fitted below with a sheet-iron cover, or shield, to prevent contact with the tow arriving by the endless apron. The second doffer is separated from the third by a tin plate. The doffer is placed too high to require any protection.

Another iron cover keeps the carder constantly separated from the roller of the endless apron, which it would otherwise indubitably touch when loaded to a certain extent.



TOW AND JUTE CARDING ENGINE.—FIG. 1.

The supports of the rollers, fixed and movable, play a certain part in the action of the engine (see Fig. 1).

Fig. 5 shows the detail of the supports *a* of the axes of the strippers E^1, E^2, E^3; they are fitted with bronze bearings, mounted on screwed rods which pass through the nuts a^1, fixed by means of spiral springs, which are supported by the cast-iron crown which forms the frame (see Fig. 1). By this arrangement the exact height of the strippers and their parallelism with the drum is secured by turning the supports to the right or left, and securing them in position by the nuts already mentioned.

The supports *f* of the axes of the working rollers F, F^1, F^2, are arranged and adjusted in the same way. But as these cylinders require at times to be shifted through extremely small distances, each of them is furnished with a small piece of iron, f^1, which moves in a slit in the framework, and, being provided with a screw and two nuts, regulates the supports to a great nicety. The two movable supports, *g*, of the discharging cylinders G, G^1, G^2, requiring only to be regulated horizontally in order to keep the proper distances between their teeth and those of the drum, are furnished with small screws, which are moved forward and backwards by means of the nuts g^1, which bear against the fixed pieces. These supports, adjusted on the thickness of the arms, are cast in one piece with the right and left plates of the frame. The intermediary wheels, U^1, R, R^1, are mounted on the pivots, *k*, fixed by bolts, and forged with a stay, or flange, at right angles, in which is a slit into which the bolt enters, and is thus easily adjusted.

The two supports d^2 are keyed on to the circumference of the circular part of the frame B^1, and in which the two feeding cylinders *d* and d^1, Fig. 1, are mounted; the fixed supports at the end of the arm B^2 are cast with the frame, and in these move in threes, on three horizontal axes *m*, nine cylinders K, which draw the carded slivers; and the cast iron squares n^1, Fig. 2, fixed on the three iron traversers *n*, which cross the whole width of the machine and serve as guides to the pressure cylinders K^1. The funnels I, which narrow up the slivers delivered by the doffing knives, and the springs of the rubbers *y*, which are continually cleaning the rollers of the pressure rollers of the take-up cylinders, are supported by the traversers *n*, of which we have just spoken; these are cast with little brackets, on which rest the thin plates n^1, which serve to support the oblique rods n^2, which serve again as guides for the slivers, and conduct them under the cylinders L and L^1 of the rotary gills. These, again, have at the extremities of their axes special support l^1 bolted on to arm B^2, and by which they can be raised.

Finally, in the interior of the drum, to stiffen its axis, are iron stay rods secured with bolts and nuts; in certain cases the bolts get detached, and cause mischief by breaking the points of the screws which fix the wood of the card to the drum; and, on account of the usual construction of the engine, it has to be taken all to pieces to repair the interior; but, in some instances, a manhole is formed in the drum which gives admission to the interior by removing a few pieces.

THE THEORY OF THE CARDING ENGINE.

The tow is first laid out on the endless aprons in such a manner that a given quantity shall always occupy the same space. The aprons carry it to the feeding cylinders, which seize and convey it to the drum, which, turning at the rate of 160 to 180 revolutions per minute, attacks and breaks the fibre and carries it on to the next rollers.

It will be seen by the direction of the feeding rollers that

the upper one easily yields up its load to the drum, and is not in danger of becoming choked; but it is not the same with the other, which, turning as if commanded by the drum, would draw the fibre back again; but this is prevented by placing beneath it a stripping feeder which carries on any fibres left behind by the drum, and as the points of the teeth of the drum card act in opposition to this stripper, every fibre is carried off.

The drum then is charged with tow, which it carries towards the first pair of rollers, and a slight study of the arrows in the figures, which show the direction in which the various parts of the engine moves, will show how the work proceeds.

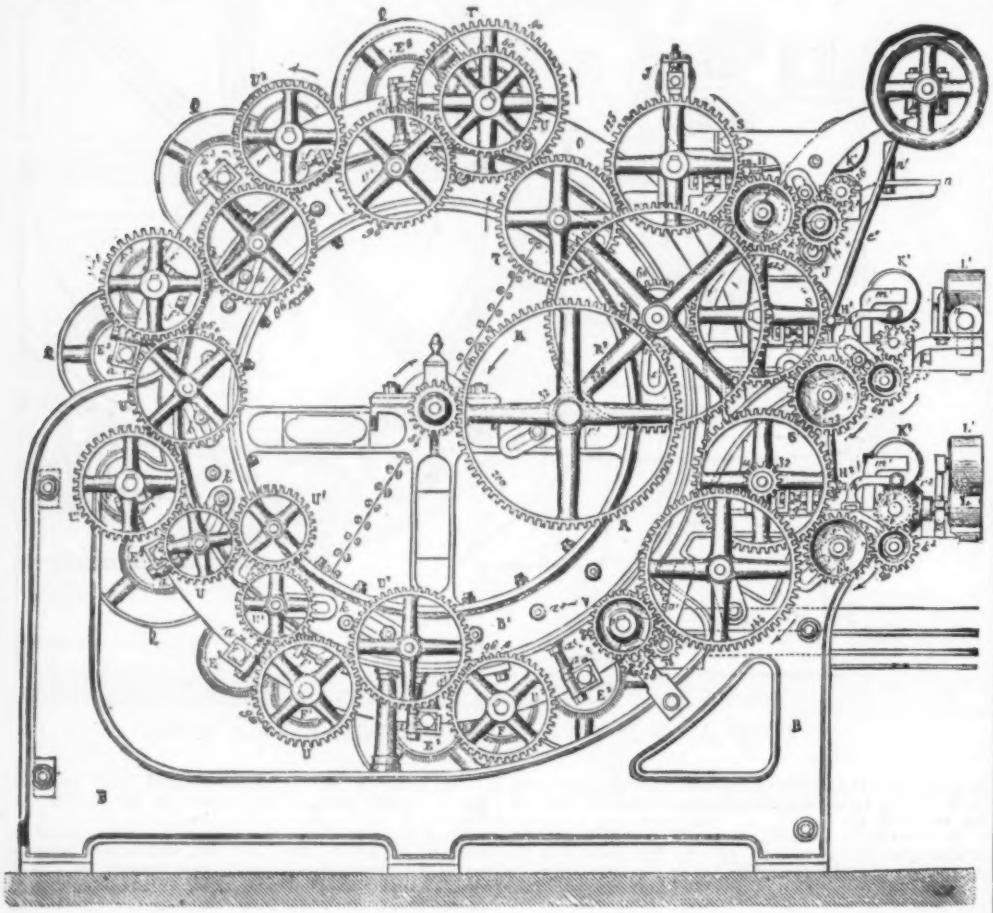
The speed of the circumference of the drum being greater than that of the stripper, the tow on the drum slips on the points of the stripper, which cannot retain it, and continues on towards the workers, which move more slowly. The teeth of the cards of the drum and workers present their points to each other, and the drum-points run—as it were—after and overtake those of the cylinder; from which arrangement it results that the points of the worker, being overtaken by those of the drum, nook the tow off the latter and carry it off in small flocculent masses towards the stripper, and this operation is properly what is called carding.

As to the stripper, its speed being much greater than that of the worker, and its teeth being in the opposite direction, it takes up small quantities of tow, which it presents to the drum in a more perfect state. The drum takes it as it did from the stripping feeder, picks a portion of it to the worker, and the rest to succeeding rollers, which repeat the process. The rollers are so placed as to gradually become nearer and nearer to each other and to the drum.

When the tow has arrived at the sixth pair of rollers, it has attained to an almost sufficient degree of division and parallelism. It is then delivered by the drum to the three doffers in the same manner as it had been previously delivered to the workers; the doffers carry it to a point where steel blades, called doffing-knives, armed with five teeth, and moving with a very rapid and sudden motion, beat against the doffers, and take off the tow in the form of a veil; this veil then passes through a funnel-like tube which reduces its width, then between two rollers, which deliver it in a sliver about three inches wide.

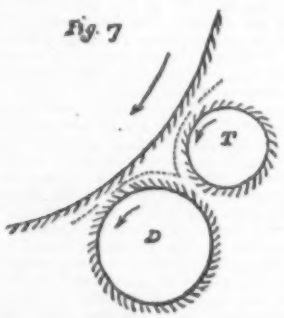
As seen in Fig. 2, the three slivers are united together on a doubling plate, on a level with the lower doffer. The doffers, being at unequal distances from the drum, furnish tow of various degrees of fineness; thus, when three different qualities are required, the three slivers are kept separate. The table and apron having three divisions, there are three times three slivers, which are all combined together on one side of the engine, and are delivered into a "can" as one until the requisite length is attained, which is indicated by a bell. Before passing into the can, however, the sliver is submitted by the rotatory gills to a drawing of 4 to 4½, and follows afterwards the same steps as a sliver of flax.

The arrangement which we have described is that of a carding engine, working, as it is called, *outside*. The tow makes the tour of the exterior of the cylinders; but there is another arrangement, known as *inside* working. In this latter case the order of the rollers is inverted, and in each pair the worker precedes the stripper instead of following it, so that the tow deposited by the drum on the worker is almost immediately seized by the stripper, which returns it to the drum. To each of these modes of working there is a serious objection.



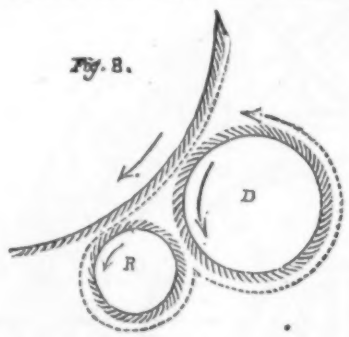
TOW AND JUTE CARDING ENGINE.—FIG. 3.

Fig. 7



First as regards the outside system; the tow taken from the worker R by the stripper D, Fig. 8, is placed by the latter in a layer which the drum brings from the preceding rollers,

Fig. 8.



and which is less worked. The better worked layer, in order to pass from one pair of rollers to another, must either traverse the less worked layer, or pass over the course *a, b, c, d*, which it has already run; if it pierce the layer which arrives, it can only be to the detriment of the carding already effected, and the fibres, instead of continuing parallel to each other, will become again partially entangled. If, on the contrary, it does not pass across and through the other, the former is liable to be turned into a kind of maze, as it were, from which there is no escape until the worker is overcharged, and then the tow which has arrived last will pass first. This evil is evidently very grave; not only is the carding undone, but the material is deteriorated, and the result must be increased waste.

In inside working the same fault does not exist, for the tow taken from the worker by the stripper is placed on the drum at a spot at which no layer has yet arrived; but, on the other hand, the carding has to be effected completely in the very restricted space between the drum, the worker, and the stripper, as shown in Fig. 7, the consequence of which is that if the material is long and not well open, it is formed into rolls, and the result is the same deterioration and increased waste.—*Textile Manufacturer.*

DETECTION OF SMALL QUANTITIES OF ALIZARINE IN PURPURINE.

By MM. E. SCHUNCK and ROEMER.

IT is easy to detect with the spectroscope small quantities of purpurine mixed with alizarine, but it is not so in the inverse case. The statement of Schützenberger that a saturated solution of purpurine in alum deposits nothing on cooling is incorrect. The compound of alumina and purpurine is deposited almost entirely on cooling. Alizarine presents the same character, with the difference that its alum lake is less soluble than that of purpurine.

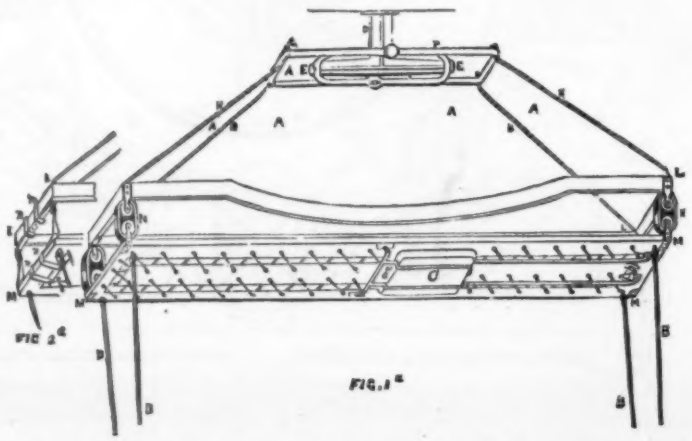
The action of the air upon the solutions of purpurine and alizarine in potash furnishes a means of detecting small quantities of the latter in purpurine.

Dissolve 15 grains of purpurine containing, for instance, 1 per cent. of alizarine, in soda, and expose the solution to the air until it is almost colorless, and the absorption bands of purpurine no longer appear upon a new addition of alkali. The purpurine is then destroyed, and the alizarine may be precipitated by muriatic acid, dissolved in ether, and examined with the spectroscope. Its spectrum is not affected by the decomposition products of the purpurine. One per cent of alizarine may thus be detected in purpurine.—*Journal of the Berlin Chemical Society.*

ELASTIC SUSPENSION HAMMOCK.

WE illustrate herewith a hammock designed by Mr. P. d'Amora, of Castellamare, fitted with universal joint and elastic suspension, the object being to obtain a marine apparatus of light structure and of easy removal, and capable of counterbalancing the rolling and pitching of the ship, as well as the translatory, and, to a certain extent vertical, motion of the centre of suspension of the apparatus.

From underneath the deck of the ship an iron bracket D is fixed in the shape of an inverted T. On the horizontal part of this fixture the cardanic suspension is articulated. This is also made of iron, with an internal circular piece F F and an external rectangular piece G G, to which are attached the four suspending iron bars that hold the hammock. The suspension is very strong, in order to enable it to resist the sudden strains resulting from sudden change in directions of motion. It is easily connected to the bracket D by means of the screws E E. The four iron bars H H have only to support rigidly the upper wooden frame L L, and are also easily connected, having at the upper and lower extremities screws and nuts. The wooden frame M M of the hammock, instead of being united rigidly to the suspension piece G, is suspended the frame L L, by means of four circular India-rubber springs N N, Fig. 1, supported by wooden pulleys, or by means of sheet steel springs Fig. 2, kept together at the extremity as shown. The steel springs may be rendered more or less flexible according to necessity by shifting the cramps *n n* by which they are held to the framework. In using circular India-rubber springs more flexibility is obtained, and therefore more effect obtained in diminishing the motion of the suspension point; but steel springs are more economical as to cost. Four very small India-rubber stays B B connect the hammock to the upper or lower deck, so as to check its motion, the tension of these stays being regulated according to circumstances. In order to balance the weight at the foot, and to give greater stability to the apparatus, its lower part is provided with a counterbalance C, sliding on two iron rods, and capable of being fixed in any desired position of its slide by means of two cords tied one on each side of the hammock. Thick curtains are placed between the suspension arrangement and the hammock, to avoid giddiness. If it is desired to use the hammock in calm weather as a fixed bed, the two frames L L and M M are fixed together with four small iron bars, and with four pieces of cord in place of the small india-rubber stays to be fastened on the lower deck. The small iron bars joining the two frames are not on the hammock made with steel springs, because in this case, to dispense with the elasticity of the hammock, the extreme slide of the cramps *n n* is sufficient. As the hammock is supported by four screws in the bracket D, these must be carefully fixed.



NEW ELASTIC SUSPENSION HAMMOCK.

HYDRAULIC MINING IN CALIFORNIA.*

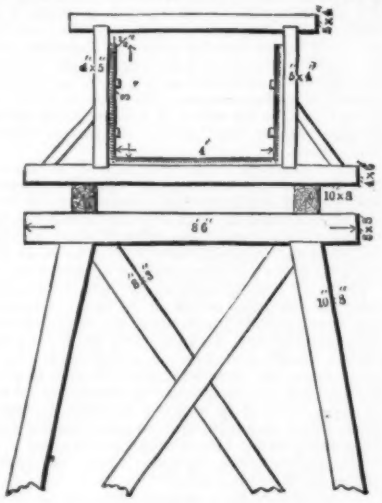
By AUG. J. BOWIE, JR., A. B., Mining Engineer.

FLUMES AND THEIR CONSTRUCTION.

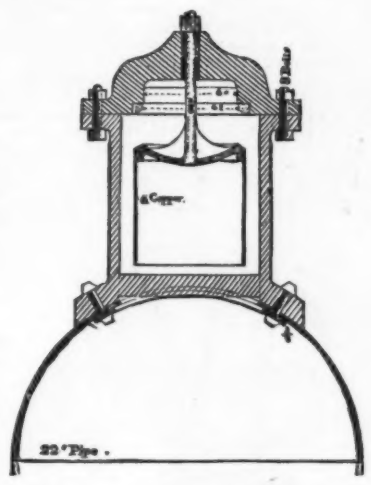
IN crossing ravines, flumes or wrought iron pipes are used. Many miners object to flumes on account of their continual cost and danger of destruction by fire. Where used, and practicable, they are set on heavier grades than ditches, 30 to 35 feet per mile, and, consequently, are proportionately of smaller area than the ditches. In their construction a straight line is the most desirable. Curves, where required, should be carefully set, so that the flume may discharge its maximum quantity. Many ditches in California have miles of fluming. The annexed sketch will show the ordinary style of construction.

The planking ordinarily used is of heart sugar pine 1½ to 2 inches thick, and 12 to 18 inches wide. Where the boards join, pine battens 3 inches wide by 1½ thick cover the seam. Sills, post and caps support and strengthen the flume every four feet. The posts are mortised into the caps. The sills extend about 20 inches beyond the posts, and to them side braces † are nailed to strengthen the structure. This extension of the sill timbers affords a place for the accumulation of snow and ice, and in the mountains such accumulations frequently break them off, and occasionally destroy a flume.

To avoid damage from slides, snow and wind storms, the flumes are set in as close as possible to the bank, and rest, wholly or partially, on a solid bed, as the general topography



SKETCH OF FLUME.



AIR VALVE FOR 22-INCH WATER PIPE.

and costs will admit. Stringers running the entire length of the flume are placed beneath the sills just outside the post. They are not absolutely necessary, but in point of economy are most valuable, as they preserve the timbers. As occasion may demand the flume is trestled, the main supports being placed every eight feet. The scantling and struts used are in accordance with the requirements of the work.

WROUGHT IRON PIPES.

The use of sheet iron pipes for conveying water in large quantities originated with the hydraulic miner. The insignificant weight, coupled with their great strength (tensile), admirably adapted them to the service for which they have been employed.

The general sizes of the pipes used in the mines are 40, 30, 22, 15, and 11 inches in diameter, of riveted light sheet iron, No. 16, 14 or 12 iron, Birmingham gauge, made in lengths of about 20 feet, and put together in a stove-pipe fashion, neither rivets nor wire being used to hold the joints in place. These pipes are light and can be readily and cheaply moved; this in hydraulic mining is of great importance, as it is often requisite to change the position of the lines of pipe. Pipe put together in this rough manner will remain tight when subjected to even as great a pressure as 240 pounds to the square inch. Where the pressure requires it, lead joints are used. (See sketch.) *A* represents the pipe; *B* the iron sleeve, between which and the pipe the lead, represented by the dotted lines, is poured. *C* is the flange, bolted to one length of the pipe on the inside for the other pipe to fit over, as shown.

Though roughly made and of very light iron, this kind of pipe (connected more like stove pipe than water pipe) is found in practice to be most serviceable, and from its form floating particles of matter readily render it water-tight. Such a pipe, 12 inches in diameter made of No. 18 iron, is riveted in the longitudinal seams every 1 to 1½ inches, whilst in the round seams the rivets may be as much as three inches apart; the rivets small ones, one-eighth or an inch in diameter, showing daylight between the iron, but after water has run through the pipe a short time nearly every leak stops. If necessary, however, 1 or 2 bags of sawdust and a few shovelfuls of earth put in the inlet, will usually make all tight.

This class of pipe is now being replaced by one of better make on which the round seams are made with rivets three-quarters of an inch apart, and the longitudinal seams are double riveted with rivets one inch apart in the row, and with about one-half inch apart from one row to the other. If riveted with care such pipes, after being dipped in an asphaltum bath, are excellent and will last for many years. For the asphaltum bath the following preparation can be used:

Crude asphaltum	28%
Coal tar (free from oily substances)	72%
Or,	
Refined asphaltum	16⅔%
Coal tar (free from oily substances)	83⅓%

When the mass has been boiled to a proper consistency, and by test the coating is found to be brittle, it at once indicates that the mixture has been boiled too hot, or that there was too much oil in the tar or asphaltum. After the pipes are dipped they are raised out of the bath and the superfluous asphaltum allowed to drip off, so there is no waste.

THICKNESS OF THE IRON, RIVETS, ETC.

The thickness of the iron is usually proportionate to the head of water and the diameter of the pipe. Pipes made of the different sizes of iron here mentioned will stand the following strain per sectional inch:

No. of Iron	Made to stand strain per sectional in. Lbs. avd'ps.
12	7,000 to 9,000
12 to 9	9,000 to 12,000
9 to 3–16	12,000 to 14,000
¼ to ¼	17,000 to 18,000

The head of the water in pounds avoirdupois, multiplied by the diameter of the pipe in inches and divided by the above co-efficients, gives twice the thickness of the iron to be used. Allowance must be made for the security required; that is, if the breakage of the pipe will cause much damage, it is advisable to lower the margin for greater safety.

The diameter of the rivets used are

No. 18	No. 16	Nos. 14, 12, 11	Nos. 10, 8, 7,	¼ in.	5-16 in.	⅜ in.
5-32 in.	6-32 in.	5-16 in.	⅜ in.	½ in.	⅝ in.	¾ in.

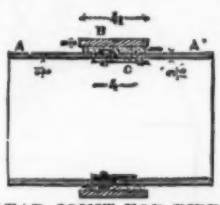
and are usually spaced to make the pipe ight, that is, closer than is necessary for the strength of the seam; but this in turn is governed by the pressure on the pipes.

When the pipe is made and put in position, air valves are provided to allow the escape of air from the pipe whilst filling, and especially to prevent any collapse should a break occur. These valves are of many forms, the most usual being a piece of leather loaded and forming a valve opening to the inside of the pipe, and when shut covering a plane hole of from one inch to four inches on the top side of the valve. Where required a better class of valve is used, which sinks and opens when the water leaves it, and floats and shuts when the water rises up to it. (See sketch.) An important point is the admission of the water in the pipe in such a way as to prevent air from being sucked into and traveling along the pipe, which will happen and in large quantities unless the water is regulated. The best plan is to put a gate in the pipe a little below the level where the water enters it, and regulate the flow by this gate, and by this means a steady pressure without violent oscillation can be obtained. Usually, however, the water first flows through a funnel-shaped pipe, which allows the air to escape as it enters, and with a little care this can be made to answer very well. In some instance an air or stand pipe is put in a distance from the entrance or inlet. This catches the air as it travels along the top of the pipe and allows its escape.

The following table shows the usual distances of rivets for corresponding thickness of iron; items relate to 22-inch wrought-iron pipe:

Thickness of the iron use	Diameter of the rivets.	Length of the rivets.	Pitch of the circle seams.	No. of rivets in each circle seam.	Pitch of the rivets in the longitudinal seams or double row.	Width between the centers of the rivets in the double row.
No. 12	5-16 in	⅞ in	1 in	69	1¼ in	⅞ in
No. 11	5-16 in	⅞ in	1 in	69	1¼ in	⅞ in
No. 9	⅜ in	1 3-16	1 3-16	59	1 7-16 in full	⅞ in
3-16 in	⅜ in	1¼ in	1 7-16	39	1 11-16 in full	1 1-16 in
¼ in	⅜ in	1¼ in	1 7-16	39	1 11-16 in full	1 1-16 in

The accompanying figures * given in tabular form show the details of construction of wrought iron pipe 18 inches in

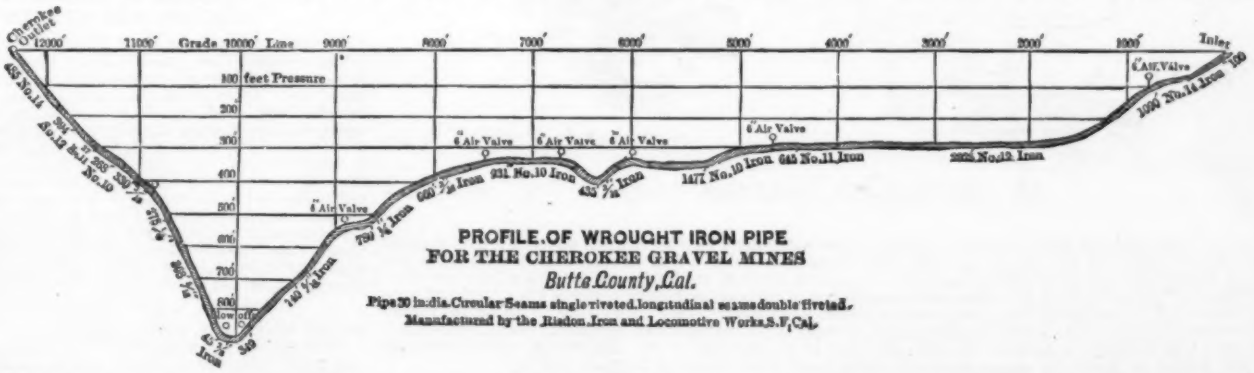


LEAD JOINT FOR PIPE.

diameter, 5,800 feet long, manufactured by the Risdon Iron and Locomotive Works, San Francisco, for the Spring Valley Water Company, which supplies the city of San Francisco. The information here afforded to mechanical engineers is sufficiently explicit for the construction of wrought-iron pipes.

This pipe has a tensile strain of about 5,000 or 6,000 pounds per sectional inch, and has been made with this low co-efficient in order to withstand the pulsation caused by a single acting plunger pump, making as high as 36 single strokes (four in length) per minute.

These oscillations are found in practice to run from five to nine pounds per stroke when the air vessel is properly


Cherokee Outlet
12000'
11000'
Grade
10000' Line
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6000'
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3000'
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Inlet
100 feet Pressure
200
300
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500
600
700
6" Air Valve
6" Air Valve
6" Air Valve
6" Air Valve
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6" Air Valve
Low off
Iron
Iron
Iron

charged, otherwise by carelessness it may exceed 50 pounds per stroke.

At Cherokee there is an inverted siphon of wrought iron. The pipe has an approximate inner diameter of 30 inches, discharging 52 cubic feet of water per second. It has been in continuous use for five years, and now in first-class order. The iron used was ordinary English plate of fair quality. The greatest pressure it sustains is 887 feet, and the thickness of the iron at that point is three-eighths of an inch.

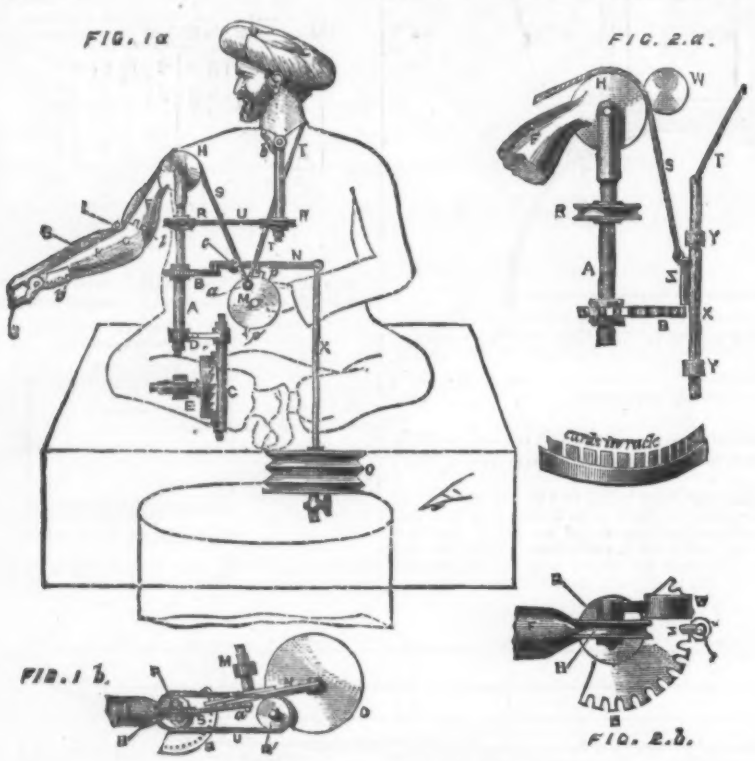
The annexed* plan, taken from the original survey on file in the office of the company, shows the line of the pipe and different sizes of iron used in construction of the siphon. The maximum strains on the several sizes of iron used are given in the following table:

Size of Iron.		Greatest Pressure.		Maximum tensile strain on iron per square inch in pounds.
No.	Thickness in decimals of an inch.	Feet.	Pounds.	
14	.083	170	74	13,374
12	.109	288	125	17,202
11	.012	293	127	15,875
10	.134	353	154	17,240
9/16	.137	455	198	15,090
3	.250	594	257	16,420
7/16	.812	842	365	17,594
3	.375	887	384	15,360

The Virginia City Water Company, Nevada, have constructed a similar wrought iron siphon, 11¼ inches in diameter. The maximum pressure in its greatest depression is 1,720 feet, equal to 750 pounds per square inch. The thickness of the iron at the lowest point of depression is No. 0. The pipe was hot-riveted, ⅝-inch rivets, double row on straight seam and single row on round seam. This pipe, when tested, is said to have stood a pressure of 1,400 pounds per square inch.†

AN IMPROVED PSYCHO.

LET me explain to those who have not seen "Psycho" that it consists of a small figure dressed as a Turk, sitting cross-legged (as shown by dotted lines) on a chest; this chest is in turn supported on a glass tube, about 12 in. diameter and 3 ft. long, which rests on a four-legged stool. The bottom of chest and top of stool are covered with green cloth, so as to make a tolerably air-tight joint. The right arm is extended as per drawing, and a semicircular rack, in which are placed the 13 cards dealt to "Psycho," is fixed by means of a bracket (not shown) in such a position that the edges come between the finger and thumb, as shown at *. The arm turning horizontally on the pivot, A, the hand can be brought over any card, and, by closing the finger and thumb, and raising the arm, the card will be withdrawn from the pack and held in the air.



AN IMPROVED PSYCHO.

In Figs. 1 *a* and 1 *b* (elevation and plan), the wheels E and M have each a train of clockwork (left out for the sake of clearness), which would cause them to spin round if unchecked. M, however, has two pins, *p p'*, which catch on a projection on the lever, N. E is a crown-wheel escapement—like that in a bottle roasting-jack—which turns A alternately to the left and right, thus causing the hand to traverse the 13 cards. A little higher on A will be seen a quadrant, B (see plan), near the edge of which are set 13 little pins. The end of the lever, N, drops between any two of them, thus causing the hand to stop at any desired card. The lever being pivoted at *c*, it is obvious that, by depressing the end, N, B will be set at liberty, and the hand will move along the cards; by slightly rising it this motion will be arrested; by raising it still more the pin, *p*, is released, and M commences to revolve, and by again depressing N this wheel will, in its turn, be stopped. Near the bottom of the apparatus is a bellows, O, which contains a spring tending to keep the lever, N, with which it is connected by a rod, X, in the position shown. This is connected with the tubular support, which may be connected by a tube through the leg of the stool, and another tube beneath the stage, with an assistant behind the scenes. By compressing or exhausting air through this tube it is obvious that the lever, N, will be raised or depressed, and the clockwork set going accordingly. *a* is a crankpin set in M, and connected with the head by catgut, T, and with the thumb by S.

At R and R' are two pulleys connected by gut. Thus if the hand moves round, the head appears to follow its motions, and when raised by pulling S, the head rises also by means of T. Further explanation seems almost unnecessary; *l* is a stop to prevent the elbow moving too far, and *b b* spiral springs, to keep thumb open and head forward respectively. When N is raised, M pulls T and S, the latter closing thumb, and then raising arm by pulley, H. If the lever is allowed to drop, *p'* will catch and keep arm up. On again raising N, the arm will descend.

Figs. 2 *a* and 2 *b* show another and simpler arrangement, in which only one train of clockwork is used. On the same axle as H is fixed a lever and weight, W, to balance the arm. A vertical rod, X, having a projection, Z, slides up and down in guides, Y Y, and carries the catgut, S and T. The quadrant, B', has cogs cut, between which Z slides and stops the motion of A, which is moved, as before, by clockwork. The lower part of X is connected direct with O. When X is slightly raised, as shown, A is free to move, but on exhausting air and drawing X down, Z enters the cogs and stops the hand over a card; continuing to exhaust, the thumb closes and the card is lifted up. The details of the clockwork I leave to the ingenuity of your readers. There should be a fan on each train to regulate the speed. The figure should be so placed that your assistant can see the cards in the semicircular rack. I am afraid that I have taken up more space than I ought, but trust to be excused. —*English Mechanic.*

BOILING AND BLEACHING KIERS.

AT Messrs. Williams, Son, and Brooke's Stanley Mills, Whitefield, England, the kiers for boiling are constructed of strong boiler plate, and are supplied of various sizes, as may be required. The kier rests on beams or pillars, beneath the level of the floor, leaving the manway in the cover of the kier at a convenient height above the floor. Access into the interior is soon effected, without the use of screw keys or lifting blocks, by means of this manhole, the cover of which is secured by a screw, letter copying-press fashion, to the cover of the kier. A few turns of the screw loosens the joint, and the manhole door is readily swung round on a pivot entirely clear of the opening. Inside the kier, and at a few inches from the bottom, is a perforated plate on which is placed the material to be boiled, and the capacity of the vessel we inspected is such that it allows of having stowed within it about 100 or more bundles of yarn, which it is advantageous to have loosely tied. The liquors, contained in tanks conveniently situated, are introduced through a pipe placed on the top of the kier, and in the centre of the cover, and in order to avoid injury to the yarn by the impact of the volume of water, a perforated deflecting plate is placed immediately in front of the orifice of the supply pipe, which distributes the liquor evenly through the space inside.

We noticed the absence of the vertical or "puffer" pipe up the centre, seen in other boiling vessels, and the obvious advantage of there being no interference with placing the yarn or cloth by reason of its removal scarcely needs to be indicated. The joint in the manhole having been made, which is expeditiously done by the contrivance employed, a vacuum is obtained in the kier by exhausting the air with a small steam engine, which has a double-acting air-pump, of special construction, attached to and driven by it. A good vacuum, as indicated by the vacuum-gauge, is soon obtained. the soda-ash solution is then run in at boiling point, and steam is turned on through the ejector or "elevator." The pipes in connection with the vessel are so disposed that a continuous circulation of the boiling liquor is kept up, that coming from the bottom passing through the ejector, which elevates it again to the top, and thus by the descending current in the kier the complete scouring of the yarn is ensured. Arrangements are provided by which the steam pressure in the boiling kier can never rise beyond a fixed limit, and, after the boiling has been commenced it may be left to take care of itself for the time required to finish the operation. It will be readily seen how, in consequence of the entire removal of the air, the fibre is instantaneously filled with the solution, the yarn being thoroughly wetted out at once. It is well known how, when yarn is boiled in the open cistern, the outsides of the bundles get more boiling than is good for them, on account of the great amount of time which has to be allowed before the centre of the bundle is even wetted, owing to the difficulty of expelling the air from the yarn. For boiling cloth the kier is also adapted, as it admits of being worked as may be required, with or without the vacuum.

The steam used for boiling is not of very high pressure, as it is known that the increased temperature due to the higher pressures somewhat impairs the strength of the yarn. After completion of the boiling operation, the liquor is run off by opening a valve, and rapid cooling down is effected by washing off with cold water passed in through a pipe fitted to the kier for the purpose. The bundles, after removal from the vessel, are placed in the hydro-extractor, and the excess of moisture "whizzed out" by its rapid revolution.

The bleaching kier, constructed of cast iron, is also provided with a perforated false bottom, and a spreader for the entering liquor at the top. It is lined with lead, and lagged with wood. The chlorine and acid solutions are conveyed into this kier by means of leaden pipes, and the fittings, such as steam and vacuum-valves, and the means of starting the exhausting engine are all so conveniently arranged that the man in charge standing in one place has complete command of all the valves, and, without moving his position, can alternately repeat the operations of exhausting and refilling the kiers.

After filling the vessel with yarn, the bleaching is accomplished as follows:—The exhausting engine is set to work, and as in the boiling-kier, a vacuum having been obtained, a valve is opened, and the chlorine liquor flows in both at top and bottom, and thoroughly permeates the fibre. It is allowed to remain in for some fifteen or twenty minutes, when, by opening a valve, air is admitted, and the bleaching liquor flows out into its cistern, situated underneath the kier, and below the level of the floor. This operation is repeated several times, the oxygen in the air alternately admitted with the bleaching liquor, playing, it is claimed, an important part as oxidizing, and so destroying the coloring matter of the yarn, which it is the object of bleaching to remove. After washing well with water, and again exhausting, the dilute sulphuric acid solution is passed in, and run out into its cistern, also placed beneath the kier, as often as may be required, and, as the vessel is exhausted of air each time before introducing the "sours," the yarn is uniformly acted on throughout.

After "souring," water is admitted at the top of the kier, and the material well washed off. If necessary, a second boil or scald can be given by means of the "elevator," and the yarn washed off as before, the operations of chlorining, washing, souring, and rewashing being accomplished without the removal of the yarn or fabric from the kier. The washing water can be caused to circulate by the ejector or "elevator," and by its means all traces of chlorine and acid are removed. The solutions of the chlorine and acid are used continuously for months, requiring only an occasional strengthening up. In witnessing the bleaching process with these kiers, we detected but slight escape of chlorine gas, and this results from the slight agitation to which the liquor is subjected. This feature, so conducive to the comfort of the operatives, is in striking contrast to what we observe when other means are used to circulate the solutions. After removal from the kier, the hydro-extractor is again put into requisition to expel the water from the yarn, which then passes to the drying stove.

The whole of the arrangements seem to be well conceived, and ably worked out, with a view of obtaining thorough efficiency and compactness. The apparatus we saw is so complete, and occupies such a small space, that a man and a boy can boil and bleach 1,000 lbs. of yarn per day with much less handling and risk of breakages than is ordinarily the case, to say nothing of the superior quality of the work, and, we may add, that in the boiling-kier we could not help observing the entire absence of escaping steam, which is so wasteful and inconvenient. These kiers have been largely used, with good results, for bleaching cotton yarns in the cop, hank and warp; and they also admit of like treatment for large bundles of chains in bulk, and on the same principle vessels of greater capacity are used for bleaching pieces. Further, the apparatus may be used for dyeing linen yarns some of the aniline colors, scouring wool, etc.—*Textile Manufacturer.*

HEATING DYE VESSELS.

EXPERIMENTS made by M. P. Havrez have yielded the following results: When considerable quantities of wool have to be treated, it is best to apply large coppers, heated by a naked fire. These are sometimes twelve feet in diameter and five feet deep, and capable of containing from twelve to twenty baskets of wool of thirty or more lbs. each. Small coppers heated by steam are less advantageous; it is difficult to obtain the same tint with them; they require more hand labor, do not get so much out of the dyestuff, and do not utilize the heat so thoroughly:* and large vessels condense quantities of steam, if that is used instead of a naked fire.

In practice it is found that vessels having a capacity of twelve cubic meters (about 400 feet), containing therefore when full 12,000 kilos. of liquid, require to heat the solution from 20 deg. to 100 deg. C., or through 80 deg.

$$12{,}000 \text{ kilos.} \times 80 = 960{,}000 \text{ units of heat,}$$

the unit being 1 kilo. raised 1 deg. C.

Now, a steam boiler consumes on the average 2·5 kilos. of coal per horse power per hour, so that, at the rate of 7,000 units of heat per kilo. of coal produced, we have:

$$7{,}000 \times 3{\cdot}5 = 17{,}500 \text{ units.}$$

To obtain 960,000 units of heat, then, we require the $\frac{960{,}000}{17\,500}$ times the steam of a boiler of one horse power, or more than forty-times the steam required by a one horse-power engine

* The *Mining and Scientific Press*, of January 7, 1871, contains a detailed account of the construction of this pipe, and also gives a diagram of the line.

† The Virginia City Water Company has constructed a second siphon, made of lap-welded pipe, 10 inches inner diameter, ¾-inch iron, and placed it alongside the siphon already built.

* It would be interesting to examine all the causes which effect economy of dye-woods when a naked fire is used in place of steam. Those which seem to influence the dyeing are: 1. The high temperature of the steam, which, wherever it touches the wood, congeals the albumen, and thus, as it were, seals up the coloring matter, while a bath which is heated gradually and uniformly dissolves the coloring matter freely. 2. The temperature of the bath and its concentration. 3. The wool is thrown up and turned over by the violent ascent of the heated water produced with a naked fire, and thus becomes dyed of a more uniform tint than when steam is used, though the last point is contested.

per hour, and this is supposing that all the heat is really transmitted.

Thus all the steam produced by a ninety-six horse-power boiler would be required for half an hour, and with the steam from a twenty-four horse-boiler these large coppers would have to be heated two hours before the steam engine was set in motion, which is scarcely practicable. Or, the water may be heated previously in a special vessel, taking advantage of hot water pipes, lost heat, etc. In the Dictionary of MM. Legris and Choisy, under the head of *Chaleur Perdue*, a method is mentioned of making the water fall like rain through a current of steam, which raises the temperature above fifty deg. Centigrade, it being afterwards raised to boiling point in the coppers by means of steam at high pressure.

For small vessels, heating by steam is by far the most advantageous, even when a steam-engine boiler is not at hand, especially when the number is considerable, and the contents vary from seventy to one hundred cubic feet of water, in which about two cwts. of wool can be worked at a time.

Here is economy (1) in labor, only one stoker being required; (2) in time, nothing being required to raise the heat but the turning of a cock; (3) in fuel, more heat being lost in one large furnace than in ten small ones; the smoke is better consumed, the heating surface of steam boilers is better arranged than in coppers, so that the heat of the flames is more completely absorbed; (4) the vessels—for they may be of wood in place of copper, especially if used for the same color.

The work is better done with steam heating. 1. The required heat is obtained exactly. 2. The wool, etc., is equally heated throughout, while with a naked fire the action of the mordants and coloring matter is far from being uniform when close to the hotter parts. 3. The dye-stuffs in powder which may be precipitated are not burned. 4. Heating by steam does not cause so much dirt as heating by coal.

In heating by steam the following conditions are necessary: 1. The vessels must be near the steam boiler, and of course those which are to be raised most in temperature should be nearest; 2. When condensed steam does not injure a bath,* from the double bottoms or worms, and—2. To let the condensed steam be received in an enclosed reservoir, having below a valve which opens by means of a float, when the water reached a given height; by this arrangement a greater part of the heat is used, if by an excess of pressure in the boiler the pipe does not condense all the steam which penetrates it.—*Album du Teinturier.*

* Pierced worms should not be used for wool in the flock because the steam issues out at the parts under the least pressure, the least immerged, while the water of the bath enters through the holes lower down, ascend the worm, and issues higher up with the steam: this current draws the wool against the lower holes, and, according to a dyer's expression, "makes a wig." This inconvenience does not arise when all the holes are on the same level.

apparatus for dyeing wool in flock have the steam admitted at the bottom, striking vertically against a cap placed at about nine inches from the bottom, whence it is thrown laterally through holes not more than one twelfth of an inch in diameter;* for dyeing fabrics, the steam is made to issue from a ring placed near the bottom and drilled full of holes at its lower side; these holes gradually enlarge about one-third per annum by the action of the steam. 3. The apparatus, which is heated by contact, instead of by the introduction of steam, has either a double bottom or a worm. The best forms of this apparatus are figured in a work on applied heat—"Chaleur Appliqué," par Peclet, 1860. The serpentine pipe, turned several times round itself, and fixed near the bottom in a horizontal plane, is the best, because the liquor near the bottom will otherwise remain cold, that above alone being at boiling point. The pipe must be movable, to allow of the apparatus being thoroughly cleaned: it may be connected with the pipe outside by means of an India rubber joint piece.

It is convenient: 1. To have a stop-cock to expel the air

* When the composition of the contents is required to be maintained permanently, the steam should only be reduced to heat the water up to 60 degs. C., when the pieces to be dyed are put in, the steam is turned off, and the work finished by naked fire or by steam contact.

SUGGESTIONS IN DECORATIVE ART.—CEILING FLOWER IN CARTON-PIERRE. *From the Workshop.*

Size: 2 m. long, 1.70 m. broad, and 0.31 m. high.

FORGING OF CHEQUES AND BANK-NOTES BY PHOTOGRAPHY.

THE tinting of cheques and bank-notes, and the marking of them with fine designs, instead of rendering them incapable of reproduction by means of the camera and otherwise, appear rather to facilitate imitation than otherwise. Take, for instance, the fine type printed upon the Cheque Bank cheques. At first sight such a precaution as this might seem to the uninitiated a great safeguard. The whole surface of the cheque is covered with "The Cheque Bank, Limited, the Cheque Bank, Limited," &c., and in such small characters as hardly to be read by the naked eye. But what would be more easy than for a clever photographer to enlarge these words, to trace them over in black ink, and then reduce them again to the proper size upon a clear negative? And once the latter is obtained, an engraved plate could be produced in one way or another without difficulty. It would be a question whether such a roundabout plan of proceeding is really necessary. The type, as we say, is so small that, if the words were not actually reproduced by photography from the original, it would be hard to find out the difference, supposing the words had been copied by hand with some exactness, and the copy afterwards reduced.

Most foreign bank-notes have microscopic type of this description upon them, setting forth that forgers are liable to so many years' transportation. This small type, indeed, has been regarded for a long time past as a special safeguard, and so it might have been before the days of photography. But capable forgers would find this type more easy to imitate now-a-days than the rest of the document, and those, therefore, who are used to telling a good note from a bad one by these means would find themselves deceived.

Again, in the case of tinted cheques. There are many methods, known to chemists, by which colors may be bleached, and then the cheque is easily copied. The engraving of a reproduction need not be so very good if it is to be covered with a tint, and hence the latter sometimes supply actually the means of forging. A German photographer recently told us in these columns how it was possible to copy even tinted cheques in case color cannot be got rid of. The blue ordinarily employed upon the French bank-notes appears remarkably easy of removal, and it was but the other day that a photographic plate was seized in Paris, upon which no trace of blue of the original could be found.

Colors, therefore, from the fact that they cover up imperfections in the forged plate, are rather favorable to the forger than otherwise, we would ask bankers to bear in mind. It is a singular fact, indeed, that the white and black bank-note of England, although it is usually a more valuable document than the notes of other British and foreign banks, is very rarely forged, since the paper-mark, and the engraving thereof, present difficulties which are not met with upon other complicatedly colored productions. Thus, it would seem after all, the best safeguard against forgery is to be found in finely-executed engraving upon a carefully water-marked paper.

LESSONS IN MECHANICAL DRAWING.

By PROF. C. W. MACCORD.

Second Series.—No. XIX.

On the Screw Propeller.—Continued.

THE curve traced upon the vertical revolving cylinder by the pencil connected with the falling weight, as shown in Fig. 117, is that to which the "guiding iron" is to be formed on the size of the cylinder. Now it need hardly be said that in making the mould, it is necessary to strike up a portion of the acting face considerably larger than the actual blade, a liberal margin all round, that is, on the rim as well as on the edges, being allowed for making a joint when the parts of the mould are put together. Therefore the "guiding iron" is laid out on a cylinder whose radius is larger than that of the propeller. But when it is made, it controls absolutely the rate at which the "sweeping-board," or revolving that of the propeller itself; and another drawing, if possible full size, and at any rate on a large scale, should be made for the guiding iron; on which the dimensions should be carefully figured, the lengths of ordinates, or elements of the cylinder, as measured from an assumed base line, being given at short intervals.

Now, in Fig. 127, we give a complete drawing of the hub and one blade of a propeller whose acting surface is such as we have been considering. Beginning with the side view.

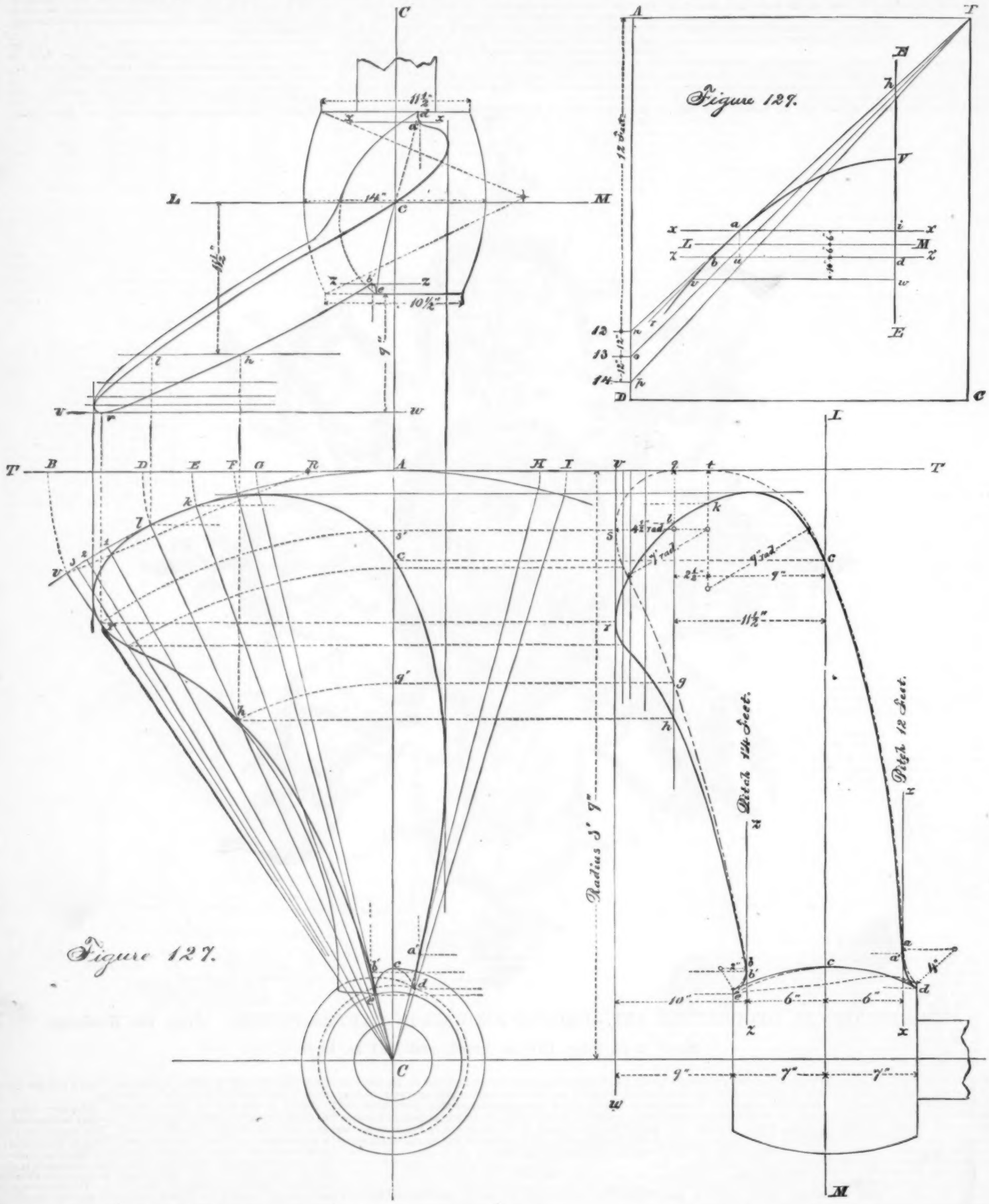


Figure 127.

LESSONS IN MECHANICAL DRAWING.—SECOND SERIES.—No. 19.

in order to "strike up" the blade of a screw in which the pitch "expands uniformly from forward to aft." From the nature of the case, as the attentive reader of the preceding lesson will have perceived, this curve is most readily laid out by first constructing its development, and then transferring the measurements thus determined to the surface of the cylinder. We saw that the development would in every case be a parabola, of which the scale and consequently the exact curvature depend upon the rate of increase and also straight-edge, which rests upon it, shall rise or fall. And if it can do this in the foundry, it can do as much in the drawing office. That is to say, if this curve be constructed on a cylinder of any assumed diameter, the position of the generating radius can at all times, and at any part of the revolution, be ascertained by means of it. In making the full drawing of the screw, however, it is obviously most natural and convenient to construct the development of the outer helix, that is, of the curve on a cylinder whose diameter is we draw first the horizontal centre line, and then, as a convenient reference line, the vertical centre line *L M*. Setting off 7 inches on each side of this, we draw the forward and aft ends of the hub, whose diameters in this case are not equal, the former being 11½, the latter 10½ inches. In the middle of its length the hub is 14 inches in diameter; we thus have three points through which a circular arc is to be drawn, on each side of the axis, to complete the outline of the hub; for which the radius and centre are most readily found

by trial and error, although there is no serious objection to making the ordinary geometrical construction if the operator has nothing more important to occupy his time. Next, we set off 6 inches on each side of *L M*, and draw two indefinite verticals *x x* and *z z*; tangent to each of these is drawn a circular arc passing through the adjacent corner of the outline of the hub; and these arcs are the beginning of the dotted outline of the space within which the blade is to swing round. The remainder of this outline is sufficiently defined by the diagram; the centres and radii of certain circular arcs which form a part of it are marked, for the purpose of locating accurately some particular points in the outline of the blade in the different views, as will presently be explained.

The diameter of the screw is 7½ feet; the pitch at *x x* is 12 feet, and at *z z* it is 14 feet. Before going farther, we must construct the development of the outer helix, which is done in Fig. 128. The method used is that illustrated in Fig. 126, since for our present purpose we need only a small portion of the parabola, quite remote from the vertex, and wish to draw it on a pretty large scale. We draw, then, the horizontal *x x*, *z z*, 12 inches apart as measured by the same scale as that used in Fig. 127; these two lines corresponding to those similarly lettered in that drawing.

On *x x* take any point *a*, and set off *a m* equal to the circumference of a circle whose diameter is 7½ feet, that is, 23 feet 6½ inches, measured by any convenient scale, the larger the better. Draw the indefinite vertical *m y*, and on it set off, *by the same scale*, *m n* = 12 feet, *m o* = 13 feet, *m p* = 14 feet. Draw *n a*, *o a*; then *n a* will be the tangent at *a* to the parabola, which will pass through *b*, the intersection of *o a* and *z z*. Draw the vertical *a u*, and subdivide *b u*, *n o*, into the same number of equal parts, in order to find, as in Fig. 126, points on the parabola between *a* and *b*. Continue the spacing on *z z* to the left of *b*, and subdivide *o p* similarly to *n o*, in order to extend the parabola in the direction *a b*; also it will be well to set off a space or two on *z z* to the right of *u*, and one or two subdivisions on *m y* above *n*, and thus prolong the parabola a little in the direction *b a*: all as in Fig. 126. Now bisect *a u*, and through the point of bisection draw the horizontal *L M*, cutting the curve in *c*. This point, it will be seen, may be taken to correspond with *c* in the top view of Fig. 127, which there represents the end of the vertical element *c c* in the other views, Fig. 128 being regarded as a portion of the plane tangent to the outer cylinder of the screw along its highest element, which will appear in Fig. 127 as *T T*, tangent to the circle of the rim in the end view. Drawing then through *c*, the vertical line *V V*, the latter will be the projection of the axis *C D* upon this tangent plane; and we can now make use of this development in drawing the screw-blade, as follows.

Beginning at the after side, we observe that our dotted outline, in the side view, Fig. 127, is limited by the vertical line *w v*, to which the outline is tangent at *s*. This line *w v* is 16 inches aft of *L M*; and may be regarded as the edge equal to *F H*, *A R* to *G c*, and the curve *P R N* is the guide view of a plane, containing an element of the screw-surface. In Fig. 128, draw *w v* 16 inches aft of *L M*, and parallel to it; this will be the rectification of an arc of the circle of the rim, and is to be set off as *A B*, on *T T* in the end view of Fig. 127. Wrap *A B* upon the circle of the rim; the mode of doing this is again introduced, *A R* be made equal to ¼ *A E*, and the arc *B v* being described about *R* with radius *R B* = ¾ *A B*. Having thus found the arc *A v*, which is equal to *A B*, draw *C v*, the true position of the radial element containing the point whose highest revolved position is *s* in the side view; project *s* to *r*, revolve it to *r*, and counter-project this point to *r* on *w v* in the side view. We thus locate the true position of the extreme aft point of the blade, the outline of which will be tangent at this point to *C v* in the end view and to *w v* in the side view. Also in the top view, *w v* being drawn 16 inches aft of *L M*, is the indefinite projection of the same element, to which the outline of the blade as there seen will be tangent at *r*.

Next, the dotted outline of the space swept out by the blade is tangent to that of the outer cylinder at *q*, 11¼ inches aft of *L M*. In Fig. 128, then, we draw *l h* parallel to *L M* and 11¼ inches aft of it: returning to our end view we set off *A D* = *l h*, wrap it down on the circle as before, thus determining *l*, the point at which the outline of the blade will be tangent to the circle of the rim: project this to *l* on the vertical through *q* in the side view, and we have another point in the true outline of the blade as there seen. This vertical, *q h*, cuts the dotted outline of the space at *g*, which is therefore the highest revolved position of another point on the same element of the surface. But this element is seen in its true position in the end view as the radius *C l*; therefore project *g* to *g'*, revolve it to *h*, and counter-project that point to *h* on *g g*. In the top view draw a parallel to *L M*, 11¼ inches aft of it, and project *l* and *h* up to this parallel from the end view.

The portion *q t* of the dotted outline being also a part of the outline of the cylinder, it is clear that in the end view the blade will for a corresponding distance coincide with the circle; and *t* being 9 inches aft of the central reference plane, we draw in Fig. 128 another horizontal 9 inches aft of *L M*, set off the distance *t k* thus obtained as *A E* in the end view of Fig. 128, from which as before we find *k*, which is projected to the vertical through *t* in the side view: then *l k* is the circular portion of the blade-outline in the end view, and *t* being a point of tangency, *k* will be one also.

The dotted outline of the space swept out by the blade in swinging round, of course contains the highest revolved positions of all the points in the outline of the blade, itself; and the upper point *e* on *L M* being seen in its true position, which is also the highest one, the outline of the blade will be tangent to that of the space at that point in the side view.

Thus we see that the mode of operation in this case is not essentially different, after we have ascertained the positions of the elements, from the general methods previously explained and employed. The actual construction of the drawing of the propeller is decidedly more simple than in the case of the radially expanding pitch, inasmuch as the generatrix always lies in a plane perpendicular to the axis; and it is more complicated than in the case of the true screw, only because uniform angular motion is not accompanied by uniform axial advance, which obliges us, for each assumed advance along the axis, to refer to our parabolic curve in order to ascertain the corresponding rotation, or the converse. But having determined, as above explained, the critical points of tangency, we may in locating intermediate points save some of the labor of wrapping down tangents upon the circle. To illustrate: in end view of Fig. 127, radii upon which are set off *C a'*, *C b'*, respectively equal to the distances of *a* and *b* from the axis: *a'* and *b'* are then the true positions of these points of tangency, whose locations in the other views are found in the usual manner. It will be observed that while the outline of the trailing edge appears tangent to *z z*, that of the leading edge intersects *z x*: this is as it should be, since *a* is a point of contrary flexure, the arc below it lying on the right, in the side view, and the curve of the dotted outline above it lying on the left, so that the curve cuts *x x* although tangent to it.

Now in cases like the one above illustrated, it is very common to say that the *entering* pitch is 12 feet, the *leaving* pitch 14 feet, and the *mean* pitch 13 feet. Disregarding the small portions of the blade near the hub, included between the lines *x x*, *z z*, and the fillet curves *a' d*, *b' e*, it is clear that this is not a fair statement of the case, when so large a portion of the acting face lies aft of the line at which the greatest pitch named actually exists.

In the present instances, in fact the *leaving* pitch would be that at *w v*, which is 10 inches aft of *z z*. What that pitch will be may be determined by calculation, thus: Remembering that the increase in the pitch follows the law of falling bodies, as before explained, we note that the increase is from 12 feet to 14 feet in falling 12 inches; now 12 is to 14, as 6 is to 7; and the velocities being proportional to the times, we may consider this 12 inches as the distance fallen through in the seventh interval. The distances traversed in successive intervals were found to form the series 1, 3, 5, 7, etc., which carried to the seventh place gives 13; therefore the distance traversed in the first interval will be 1/13 of an inch. The total space varies as the square of the time; therefore at the end of this seventh interval we shall have 49 × 1/13, or 45/13 inches, as the distance of *z z* from the vertex of the parabola. But *w v* is 10 inches farther away, or 55/13 inches. Divide this by 1/13, and we have 59.8333, of which the square root is 7.735, the time occupied in falling from the vertex to *w v*. But at the end of the first interval the pitch was 2 feet, whence 2×7.735 = 15.47 feet, or 15 5/25 inches, very nearly, is the true leaving pitch, giving a mean pitch of 13 feet 8 1/13 inches instead of 13 feet.

In a similar manner the pitch at any other point may be

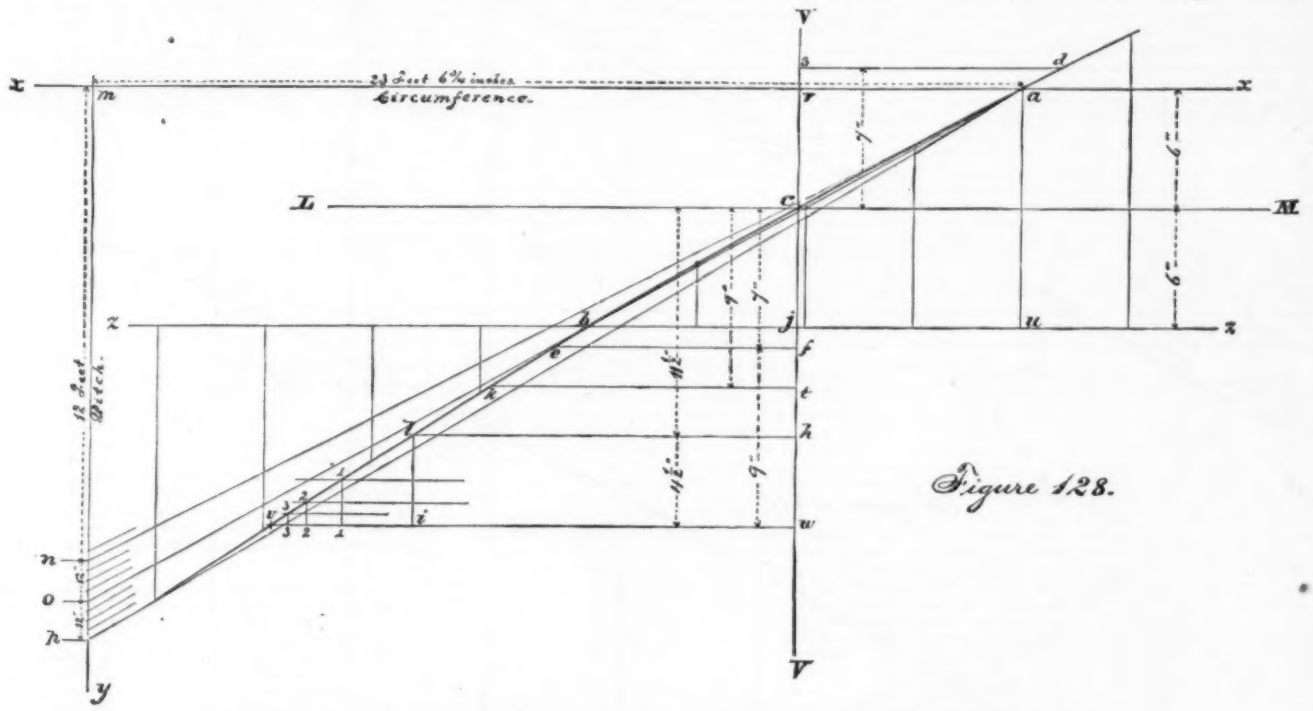


Figure 128.

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the arcs *A l*, *A v*, are equal respectively to the lines *h l*, *w v*, of Fig. 128; therefore the difference *v l* of these arcs is equal to the difference *v i* of those lines, the latter being found by dropping from *l* a perpendicular upon *w v*. If then we subdivide *v i* and the arc *v l* into proportionate parts at 1, 2, 3, and through the points of subdivision on the former erect perpendiculars to cut the parabola, these perpendiculars 1–1, 2–2, 3–3, will be the measures of the axial advance corresponding to the rotation measured by the subdivisions of the arc *v l*.

We then set off from *v w* toward *L M*, in the side and top views of Fig. 127, distances equal to these perpendiculars, and draw parallels to *L M*; these will then correspond to radii drawn in the end view through the points of subdivision on *v l*: and these lines are used in finding points on the required outline, precisely as *h* on the radius *C l* was found from *g* on *q h*, the construction being illustrated in the case of one point on radius *C* 3.

As to the intersection of this blade with the hub, the extreme point on the forward side is found by drawing in Fig. 128 a parallel to *L M*, 7 inches forward of it; the length *s d* thus found is set off on *T T* in Fig. 127 as *A I*, which being wrapped upon the circle of the rim fixes the position of the radius, which cuts the circle of the forward end of the hub in *d*; the after point, *e*, is similarly determined by the aid of *f e* in Fig. 128, which is 7 inches aft of *L M*, its length being set off as *A F* to the left of *A* in Fig. 127, in order to locate the radius which cuts the circle of the after end of the hub in *e*. The vertical element *c c* evidently pierces the hub at the lower point *c*, which is the highest point in the outline of the hub. Other points in this line of intersection *d c e* are found in a manner entirely similar, and having explained at length the mode of finding the positions of the elements, it is needless to say more in relation either to this curve or that of the junction of the back of the blade with the hub, which is here, as usual, assumed in the top view, from which its other projections can be readily determined by the familiar method of auxiliary transverse plans.

The dotted outline, as described at the outset, is tangent at *a* to *x x*, at *b* to *z z*; the corresponding lines in Fig. 128 give us the distances *r a*, *b j*, which are set off in Fig. 127 as *A H*, *A G*, and wrapped upon the circle, thus locating the calculated: but it may also be determined graphically with sufficient precision for all practical purposes, and as some may prefer that method, we give a convenient construction in Fig. 129.

The rectangle *A C* is the development of a cylinder whose circumference, *A B*, is 13 feet. On the vertical element *A D* set off *A n* = 12 feet, *A o* = 13 feet, *A p* = 14 feet, and draw *B n*, *B o*, *B p*. Draw the horizontals *x x*, *z z*, 12 inches apart, *x x* cutting *B n* in *a*; through *a* draw *a r*, parallel to *B o*, cutting *z z* in *b*. From *a* let fall on *z z* the perpendicular *a u*; then it will be seen that *b u* will represent the time occupied in traversing the 12 inches between *a* and *u*, and the pitches, 12 and 14, being as 6 to 7, this is the seventh interval, as above explained; setting off then *b d* equal to seven times, or *a i* equal to six times, the distance *b u*, the vertical line *E E* through *d* or *i* will be the axis of the parabola. This line cuts *B n*, which is tangent to the parabola at *a*, in the point *h*; *i h* then is the subtangent on the axis, and bisecting it at *V*, we have the vertex of the curve, which may then be drawn by the methods given in the last lesson.

The reason for selecting the cylinder whose circumference is 13 feet is, since *A o* the mean pitch is 13 feet also, *B o* and its parallel make angles of 45° with the vertical and horizontal lines; consequently *b u* = *a u*, and *a u* being 12 inches, we may at once set off *b d* = 7 feet by the same scale. But this is not all; the ordinates, as *a i*, *b d*, *v w*, are proportional to the times, and these to the pitches: and *b d* measuring 7 feet by one scale, will measure 14 feet by another; if then for instance we construct our diagram, setting off the distances *i d* = 12 inches, *d w* = 10 inches, by the scale of one inch to the foot, we have only to measure *v w* by the scale of half an inch to the foot, to find the leaving pitch, above calculated. It does not, however, really matter what cylinder we take; it is clear that *b u* will represent two feet in any case, and a scale might be constructed by subdividing it accordingly; but it will clearly be best to save that trouble, by making our diagram so that we can use one of those at hand. Had we made *A B* 26 feet instead of 13, it will be seen that *b u* would have been twice *a u*, so that we should measure our ordinates by the same scale as that with which we set off the vertical distances.

Of course this device will call for modifications depending

on the conditions of individual cases; but they will readily suggest themselves to any one who has attentively considered the illustration here given. It will be noted also that the sole use of the dimensions *A B*, *A n*, *A o*, is to determine the *direction* of *B o*, *a r*, and the tangent *B n*: it is not, therefore, essential that we measure the distance between *x x* and *z z* by the same scale, but we may use any other, just as we did in Fig. 128, if we like. In Fig. 129 we used the same scale, merely in order to show the relation of the portion of the parabola there drawn, to the whole surface of the cylinder; had we set off the vertical distances by a larger scale, we we should merely have had the same parabola drawn on that larger scale, the rectangle then representing a part only of the surface of the cylinder.

Now, in Fig. 127 we have shown the blade with a reasonable "substance" or thickness, supposing it to be made of cast iron. But we have not confused the drawing by introducing any of the lines employed in determining the outline of the back.

The process is the same in this case as in the others, previously described at length; and the only step in it necessary to be mentioned here, is that of drawing a normal to this surface. It will be recollected that in the case of the right helicoid, the tangent plane at any point was determined by two lines, one of which was the element, and the other the right line tangent to the helix, passing through the

merely calling attention to the circumstance that in this one instance we have not in the top view continued the imaginary back line of the blade as usual in outline drawings for reasons previously given, but have drawn merely the visible contour as it actually exists. Were the drawing shaded, this would improve the effect; but it will be noticed that in the absence of shading it requires some study and exercise of the imagination to realize the existence of a continuous edge of palpable thickness.

It need hardly be said that, although for uniformity's sake we have made all the propellers in our illustrations right-handed, there is no special reason why they should be; it depends altogether upon which way the engine is planned to turn when going ahead, and either of forms described, or indeed any form of screw, may be made left-handed if desired. And it will be well for the student to test his mastery of the processes of drawing this important means of propulsion, by constructing both modifications. But in regard to the arrangement of the views, there is one particular in which he is advised not to make any change. That is, in respect to the end view, which ought invariably to be a view of the aft side of the blade, looking forward. It is not that the drawing would be any the less correct, or any more difficult to make, if the screw were viewed from the forward side; but when it is put up in place, it evidently can be actually seen to advantage only from the aft side, and

L M midway between *x x* and *z z*, cutting the parabola in *c*, and have assumed the vertical line *V V* through this point, as the element along which the plane of development is tangent to the cylinder. Considering Fig. 130 as a top view, then, as we did Fig. 128, *V V* will also be the projection of the axis on this plane. In order to construct the drawing of the guide curve, Fig. 131, then, we take any point *C* on *V V* as a centre, and with a radius of 4 feet 3 inches describe the indefinite arc *Q S*, to which *T T* is drawn tangent at *A*. In Fig. 130, we have drawn the lines *s d*, *w v*, corresponding to those similarly lettered in Fig. 128; these determine the length *v d* of the parabolic arc intercepted between the extreme limiting elements of the blade, and the guide curve must extend a reasonable distance beyond the points *v* and *d*, as before explained. The precise distance is not material, nor is it necessary that the extension should be the same at each end; and a little experimenting with the scale shows that, by setting off 35 inches to the left, and 21 inches to the right, of *V V*, we shall have sufficient and nearly symmetrical prolongation of the curve. These figures are chosen merely because they admit of easy subdivision by the scale, which effects a little saving of time. The horizontal line *E F* is drawn through the point *E* thus determined, the vertical *F H* crected to cut the parabola in *H*, and *E* and *F* are projected to *T T* at *B* and *D*. The arc *A I* is then made equal to *A B*, and *A K* to *A D*, and *I* and *K* are projected to *T T*

Figure 130.

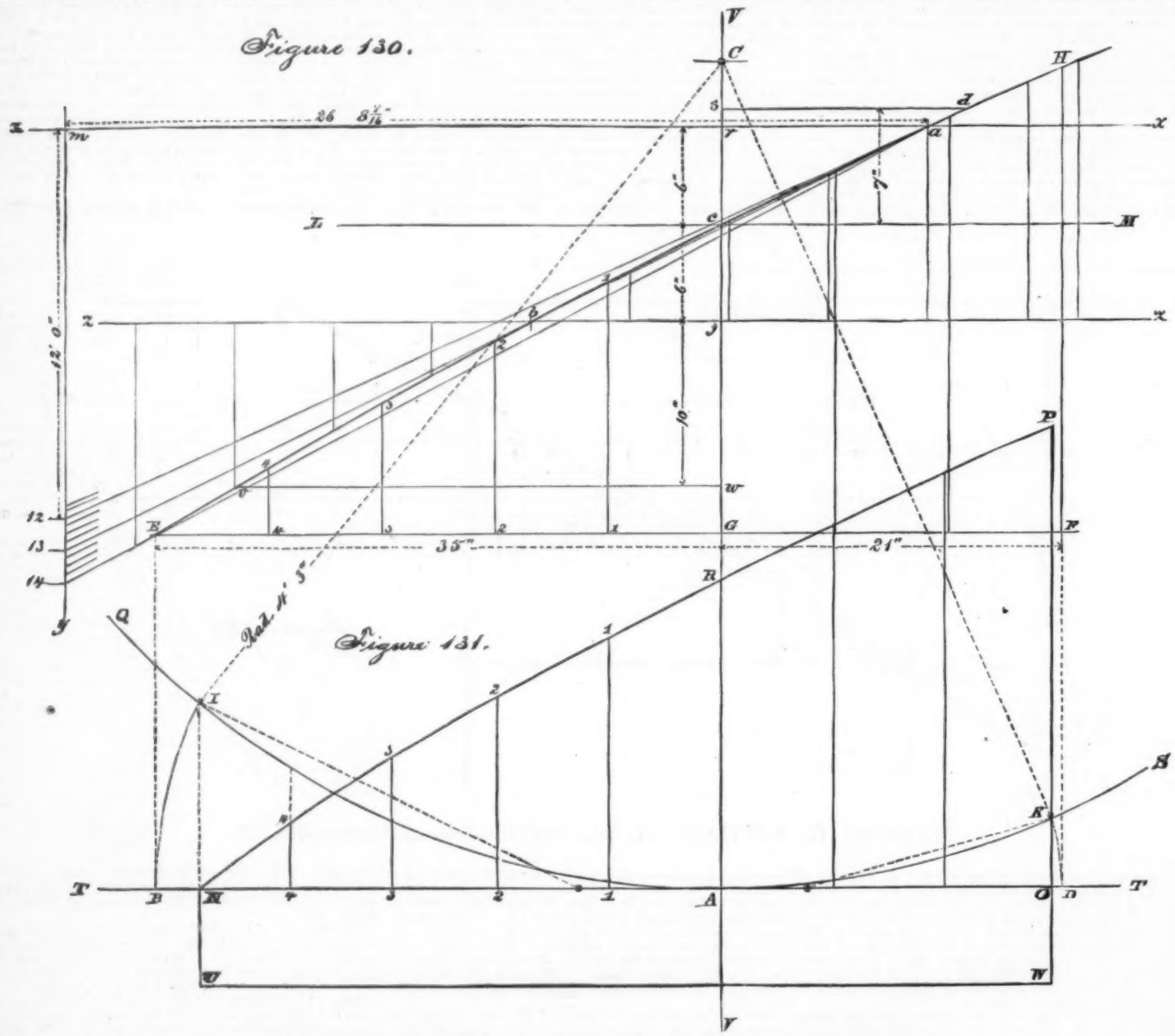

Figure 131.

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given point. The tangent to the helix, we saw, must lie in the plane tangent to the cylinder at that point; the cylinder being developed on that plane, the helix became a right line, coinciding with the tangent. In the present case, the helix not being a true one, but having an increasing pitch, becomes a parabola when the cylinder is developed on its tangent plane.

If now we draw a right line, tangent to the parabola, at the point where it intersects the element of the cylinder along which the plane is tangent, and then restore the development, that right line will be tangent to the helix, and with the element at that point will determine the tangent plane, to which the normal is perpendicular. For instance, in Fig. 128, if we draw a tangent to the curve at *c*, it will be tangent to the helix when the development is restored, *c* being placed at *A* of Fig. 127 and the plane wrapped down on the cylinder. And as *c* is the projection of the element *c c* of the other figure, that tangent, with that element, would determine the plane tangent to the screw surface at *A*, were it extended so far: and that plane being perpendicular to the paper and seen edgewise in Fig. 128, a perpendicular to that tangent at *c* would be normal, which in Fig. 127 would coincide with *T T*. In order to avoid confusion, the tangent and normal are not drawn; but as we have already given the method of drawing the tangent to the parabola at any point, we leave the construction of the back of the blade to the student, in addition to this, the whole of the acting face, which is the most interesting and important part, can be shown in the drawing in no other way.

In Figs. 130 and 131 we have shown the detail of the process of laying out the guide curve to be used in striking up the blade of the screw just described. As in drawing the propeller itself, so here the first step is to construct the development of the helix on a cylinder, of which as above stated the diameter must be greater than that of the screw. Allowing in the present instance six inches as a sufficient margin for making a joint in the mould, we have 8½ feet as the diameter; the corresponding circumference is 26 feet $8\frac{1}{16}$ inches.

Drawing then in Fig. 130 the indefinite horizontal *x x*, and assuming any starting point *a*, we set off this circumference *a m* by any convenient scale, draw the indefinite vertical *m y*, on which by the same scale we set off from *m* the distances 12, 13, and 14 feet; *s s* is then drawn parallel to *x x*, and 12 inches from it, by the scale on which the guide curve is to be laid out, which in the figure is the same as that used in drawing the screw, in Fig. 127. The parabola, or developed helix, is then constructed precisely as in Fig. 128; the construction lines are shown, but the similarity of the two diagrams renders any further explanation needless. For the sake of making this correspondence between the figures more complete, we have drawn the line

at *N* and *O*. The line *N O* is now to be used as a base line, corresponding to *E F* of Fig. 130, the vertical *O P* is made curve required. Intermediate points are found thus: *G E* is divided into any number of equal parts, at 1, 2, 3, etc., and ordinates 1–1, 2–2, etc., are erected to meet the parabola. The arc *A I* is also divided into the same number of equal parts, and through the points of division vertical lines 1–1, 2–2, etc., are drawn, their lengths measured from *N O* being made equal to those correspondingly numbered in Fig. 130. The same process is carried out in regard to *F G* and the arc *A K*: in the diagram we have made spaces of 7 inches, thus dividing *E G* into five and *G F* into three parts; but it need hardly be said that the figure is merely illustrative, and the subdivision may be carried to any extent desired. Since such a guide curve could not be used if terminating in a point as at *N*, any additional length as *N U* may be given to it, so that the complete side view of the portion of the cylinder will be the figure *U N P W*. As before remarked, the lengths of the ordinates, 1–1, 2–2, etc., ought to be marked in a working drawing; they may be determined with any desired degree of precision by calculation, upon the same principles as those used in finding the leaving pitch; but if the parabola be carefully constructed on a large scale, they may be measured with sufficient accuracy for practical purposes. It need hardly be added that Fig. 131 is made on the supposition that the propeller is to be cast with the acting face, or aft side, down.

PHYSIOLOGY.

On the Effect of Varnishing the Skin in Man.—When an animal, such as a dog or rabbit, is coated with an impermeable varnish, the temperature of its body falls, serious symptoms ensue and terminate in death. Suppression of the excretory functions of the skin is usually stated to be the cause, or at any rate one of the causes, of the phenomena in question. It is often assumed that similar results would follow varnishing in the human subject; and the assumption is supported by the old story of the boy who lost his life in consequence of being coated with gold leaf to represent an angel in a religious ceremony. Senator has put the question to the test of experiment (*Virchow's Archiv*, lxx., 182). Two healthy men allowed their limbs to be coated with impermeable plasters, while the trunk was varnished with several layers of flexible collodion. Nearly a week was allowed to elapse before these applications were removed. None of the evil consequences invariably observed in animals made their appearance; there was no fall of temperature, no albuminuria, no exhaustion, no dyspnœa, convulsion, or paralysis. Senator concludes that the gilded boy was probably poisoned by some ingredient in the material applied to his skin.

On the Coloring-matter of the Retina in its Relation to Vision.—The discovery of the so-called "retina-red" or "retina-purple," by Boll has led to the adoption, by some authors, of the hypothesis that the chemical products resulting from the decomposition of the retinal pigment by light stimulate the terminations of the optic nerve, and that this photo-chemical process is an essential factor in ordinary vision. Kühne has set himself to show that this hypothesis is, to say the least, premature (*Untersuch. aus dem physiolog. Institut in Heidelberg*, Band I., Heft 2). He points out that the retina of many birds and reptiles, whose faculty of seeing is beyond question, contain no purple, and this is likewise true of the most sensitive portion of the human retina—the *fovea centralis* and its immediate neighborhood. The large retinal rods of the river cray-fish contain a great deal of pigment; but this is singularly indifferent to the action of light, exposure to the sun's rays for several hours failing to bleach it. From these considerations it is clear that the retinal pigment cannot be essential to vision in all animals; while, from its indifference to light in some of the invertebrata, it would almost seem to be analogous to the other varieties of coloring-matter so often present in different parts of the eye—*e. g.*, the yellow of the *macula lutea*, the colored oil drops in birds and reptiles, the yellow of the lens in many fishes, the orange protoplasm recently discovered by Dr. Ewald in the anterior layers of the cornea of the perch. The following experiments show that in the frog, whose retinal rods contain a very sensitive kind of purple, the power of distinct vision, and the faculty of distinguishing colors, survive complete bleaching of the retina by direct sun-light. Frogs exposed to the sun for more than an hour (the retina is quite discolorised by exposure for fifteen minutes) were found to be able, not merely to elude all attempts made to lay hold of them, but also to capture flies; blind frogs, of course, being unable to do either the one or the other. Again, if a number of frogs are confined in a shallow dish, one half of which is roofed with green, the other half with blue glass, they will in a short time be found huddled together under the green portion of the roof. This preference for green over blue is exhibited by a vast majority, both of *Rana esculenta* and *R. temporaria*. Possible fallacies which might arise from the unequal diathermancy of the two kinds of glass, unequal intensity of illumination, etc., were carefully eliminated. It was conclusively ascertained that the preference was connected with the color, and not with any other property of the glass. Having settled this point, Kuhne introduced a number of blind frogs into a vessel of this sort, and found that they showed no preference for one part of it rather than another; while frogs that had been exposed to the sun for hours, and whose rods no longer contained any trace of purple, speedily took refuge in the green half of their prison-house.

On the Law Regulating the Exhaustion of Nerve-fibres, and Their Recovery after Stimulation.—The phenomena of exhaustion and recovery have been thoroughly studied in tetanised muscles; Prof. J. Bernstein has recently investigated the corresponding phenomena in motor and sensory nerves (*Pflüger's Archiv*, xv., 6 and 7). If an interrupted current from a Dubois Reymond's induction apparatus be sent through a short section of the exposed sciatic nerve in a frog, the *tendo Achillis* having previously connected with the lever of a myograph, it will be found, after a time, that stimulation of the plexus higher up no longer causes the muscles of the leg to contract. The conducting power of the stimulated tract of the nerve is abolished. With time and rest it may be regained; but its recovery does not take place at a uniform rate. At first it is very slow and gradual; it then goes on very rapidly for a relatively brief period; lastly, it enters on a third phase, during which its progress is once more slow, proceeding at a constantly diminishing rate as the nerve approaches its normal condition. The impairment of conductivity which results from the flow of a continued galvanic current through a given section of a motor nerve has been ascribed to a variety of causes. It is really a kind of fatigue resembling that produced by interrupted currents. The process of recovery is governed by the same law in both cases; hence it may fairly be inferred that the fundamental changes in the nerve-fibre are similar in both. Bernstein next proceeded to investigate the phenomena of recovery in motor nerves after their conducting power had been exhausted by mechanical, chemical (dilute lactic acid), and thermal stimuli. The rate of recovery was bound to obey the same law as before. On extending the inquiry to sensory nerves the same law was again found to hold good. The author then proceeds to discuss the facts in their theoretical aspect, and points out that the law deduced from them is fundamentally similar to that which regulates the recovery of organisms as a whole from the exhaustion caused by fatigue or disease; it may thus be brought into connection with the general principles of organic nutrition.

Elimination of Alcohol from the Body.—A full account of Prof. Binz's researches on this subject is given in the *Archiv fur exper. Path.*, vi., p. 287. Supposing any considerable portion of the alcohol absorbed into the blood to be eliminated without previous decomposition, it must escape through the kidneys, or the lungs, or through both of these channels at once. The fallacy inherent in the bichromate test having long since been generally recognized, Binz employed Geissler's vaporimeter for the detection of minute quantities of alcohol in the urine. A number of experiments showed that only a very small proportion of the alcohol taken (six per cent. at most) passes out through the kidneys. The breath is often supposed to smell of alcohol; but the smell noticed after any of the usual intoxicating beverages is really due to essential oils and ethers; it is not observed after a mixture of pure alcohol with distilled water has been taken. Attempts were then made to detect alcohol in the expired air, by passing it for many hours through a series of Woulfe's bottles, containing cold distilled water; but in no single case was positive evidence of its presence obtained. Binz concludes, accordingly, that almost all the alcohol absorbed undergoes oxidation in the system.—*Academy.*

ON THE PREPARATION OF SKELETONS FOR MUSEUM PURPOSES.*

By PROFESSOR W. H. FLOWER, F.R.S.

EVERYONE who has a museum, however small, should be familiar with the mode of preparing skeletons. I can only indicate the outlines of the process, for in this, as in every other part of the work of making anatomical preparations, a few practical lessons from a person already an adept, and a little experience and observation, will do more than any description. When the principles are known, the details can be carried out with such modifications and improvements for each individual case as the skill and ingenuity of the operator can suggest. With regard to museum specimens generally, the question is frequently asked how such or such a preparation is made, and an answer is expected, in a few words, which will enable the questioner to do the same himself. This is much as if a novice who had never handled a brush were to ask an artist how he had painted his picture, and expect that a few simple directions would put him on a level with the master. Preparation-making is an art which can only be acquired by labor and perseverance, superadded to some natural qualifications not possessed in an equal degree by all.

To return to the bones, as in many respects the simplest kind of preparations. There is a popular notion that skeletons are made by putting animals into ant-hills. So I have been told over and over again ever since I was a child. I must, however, say that I have never actually seen, or even heard of, a skeleton really made in this way, though ants, doubtless, especially in hot countries, will make short work of the flesh of an animal's body, leaving at least all the larger bones untouched. But we must adopt some safer and more universal applicable method of proceeding. Another common idea is that some "chemical" substance is necessary to steep them in for dissolving the soft parts, and I am often asked, "What acid do you use for this purpose?" when a little reflection would have shown that the bones would be the first parts to disappear under the influence of such a menstruum. No, water—pure water—is the only thing required in preparing bones and skeletons in the great majority of cases, and in the proper use of water the art of "macerating," as it is called, chiefly consists.

This process is nothing more or less than placing bones in water and leaving them undisturbed until putrefaction of all the flesh and blood remaining on and around them and within the hollows and small cavities of their interior takes place, and these soft parts entirely lose their form and structure and become converted into liquids and gases mingled with the water or escaped from its surface; so that when the bones are removed and well washed, nothing remains but the comparatively indestructible true osseous tissue, which, when dried, is hard, clean, and without smell.

Maceration consists, then, essentially in the destruction of the soft tissues by putrefaction, and certain circumstances are essential or favorable to the success of the process. In the first place, the water should not be too abundant in proportion to the amount of animal matter to be destroyed. Then it should never be changed or disturbed until the process is completed. The surface should be exposed to the air, and the loss from evaporation supplied from time to time. The temperature should be uniform and elevated. Cold checks the process; freezing arrests it altogether. If the heat is too great the bones are often greasy and discolored, as when they are prepared by boiling. It is to the fact that the process varies in rapidity according to so many circumstances that the chief practical difficulty, which is to know when it is completed, is due. If the bones are taken out too soon, unless they are returned immediately to the same water, a check takes place in their preparation. To estimate the necessary time is a matter acquired only by practice and knowledge of the surrounding circumstances. Much will depend upon the size of the bones, small bones macerating much more rapidly than large ones; also upon their condition. If fresh they macerate far more quickly than if they had been previously dried (as is the case with skeletons sent from abroad in a rough state), or if they have been kept in spirits or any other preservative solution.

When the bones are to be removed, the water must be carefully poured off through a hair-sieve, and all the solid matter which remains at the bottom of the jar must be carefully searched for any of the smaller bones which might otherwise be lost. They are then removed to clean water, frequently changed for several days, well washed with a brush, if necessary, and dried, if possible, in the sun.

The process of maceration is necessarily attended with disagreeable smells. So long as it continues, the surface of the water slowly emits gases; but the worst is when the water is stirred up by pouring it off to remove the bones. Hence it should be carried on in the open air, or, what is far better, in a building isolated for the purpose, and in which the temperature may be kept uniform. When maceration has to be conducted among dwellings, it is necessary to be very careful not to disturb the vessels, and to put some disinfectant, as chloride of lime, into them the day before the contents are taken out. This will obviate most of the usual disagreeable effects, and if not used in too great a quantity will not cause any material damage to the bones. But chloride of lime, when used too freely, is a dangerous agent; it destroys the gelatinous portion of the osseous tissue (which of course is not removed in maceration), and leaves the bones white, chalky and friable. After proper maceration no chemical bleaching is required. Exposure to sunlight or alternate sun and rain for some months is generally good, especially for large solid bones, though this may be carried too far, as the intensely white, cracked, porous and fragile condition of osseous fragments, which have been lying long on moors or hill-sides, shows. Bones are not naturally of a pure white color, but have a delicate yellowish or creamy tint like that of ivory.

Several substitutes for the process of maceration in water are occasionally adopted under special circumstances:

1. Boiling. This process has the advantage of rapidity, but is seldom resorted to except when absolutely necessary (as in the case of the celebrated skeleton of the "Irish giant" in the Hunterian Museum), as the fatty matter in the medullary cavity is melted and pervades the whole osseous tissue, and generally leaves the bones discolored and greasy, as may be seen in most of those that have been cooked for the table.

2. Burying in the ground may be resorted to when there are no conveniences for maceration, but it is even a slower process. The effect upon the bones is the same, but they are nearly always stained brown by the coloring matter in the soil, and the small ones are apt to get lost.

3. It has occurred to me, following out a suggestion of Mr. Seymour Haden's, in his excellent letters entitled "Earth to Earth," relating to the best mode of disposing of the dead, to clean bones by burying them in a basket of charcoal, and though the experiments are not quite complete they promise excellent results, especially as all the disagreeable odor of maceration is entirely obviated, and the process may even be carried on in inhabited rooms without any inconvenience.

MILK AS FOOD.

The economic value of milk as an article of food is appreciated neither by the producer nor the consumer. It is one of the most important foods which nature has supplied for the use of man, since it contains all the elements of nutrition within itself, and in the most digestible form. Probably no article on the farm is produced and sold at so small a margin of profit as in the case of milk, and yet in its various forms of milk, butter, cheese and cream, it constitutes one of the most indispensable requisites of the human race.

The ingredients of milk consist of nitrogenous or flesh-forming matter, fatty or heat giving and respiratory food, sugar, mineral matter or ash and water. The butter and the sugar of milk are employed in the production of fat, and are what have been styled by physiologists heat-producers and fat-formers. The casein or cheesy portion resembles the gluten of wheat in composition, and belongs to the class of food substances termed flesh-formers. The ash, or mineral part of the milk, is chiefly employed in forming the bones of the young it is destined to nourish.

In point of nitrogen or flesh-forming food alone, one gallon of milk, costing at retail twenty-eight cents, is equal to one pound of lean meat; three quarts of milk is equal to one pound of fat meat; two quarts is equal to one pound of bread, while it takes eight pounds of potatoes to yield the equivalent of four pounds of milk. In estimating the nutritive equivalents, calculated according to the amounts of nitrogen in the dry substances, human milk being at 100, Indian corn stands at 100, wheat 119, beans 320, cows' milk 237, cheese 331, oysters 305, mutton 773, fish 850, beef 880. In the production of the carbonaceous elements for fattening, heat-giving and respiratory functions new milk is less expensive than beef, while in the flesh-forming constituents it is cheaper than pork, bacon or vegetables, and nearly equal to beef.

Cows' milk is composed of about eighty-six parts water and fourteen parts solid matter; the latter is made up of about 4.1 per cent. casein, 3.9 butter or fat, 5.2 sugar or lactin, 0.8 per cent. of mineral substance. An imperial gallon of milk weighs ten pounds and four and three-quarters ounces, and contains about one pound and seven ounces of solid matter, or 6.4 ounces of butter, 6.7 ounces of casein, 8.5 ounces of sugar, and 1.24 ounces of mineral matter. At first sight the proportion of water seems large, yet eggs have 74 per cent. of water, salmon 77, lean beef and mutton 72, fat beef and mutton 52, potatoes, 75, turnips 91 and parsnips 82 per cent.

As an article of food new milk is more economical than beef. The carcass of a fat calf contains 37.7 per cent of dry substance and 62.3 of water; that of a half-fat ox 46 per cent of dry substance and 54 per cent of water; while the carcass of the fat ox shows 54.4 per cent of dry matter to 45.6 per cent of water. The amount of dry substance in the carcass of the average ox is fifty pounds out of the hundred total weight. Basing the calculations on a retail selling price for beef of twenty cents per pound, the one hundred pounds of carcass would cost twenty dollars, or at the rate of forty cents per pound for each pound of dry substance. On the other hand one hundred pounds of milk, containing fourteen pounds of dry substance, would cost, at a retail price of eight cents per quart, $3.60, or only about twenty-six cents per pound for each pound of dry substance.

In this connection the use and economy of milk has several important advantages over that of beef. In milk there is no bone, as in meat, nor waste in trimmings. The amount of bone in meat varies, but is rarely less than eight per cent; in the neck and brisket of beef it is about ten per cent, while in the shins and legs it amounts to one-third or even half the total weight; so that in estimating the actual cost per pound of a choice cut of beef ready for eating, it is safe to double or treble the cost per pound of the carcass. Again milk needs no cooking, hence is always ready for consumption at a moment's notice, and without being subjected to waste and shrinkage. The ordinary percentage of loss in boiling beef is twenty per cent, in baking twenty-nine per cent, while the roasting process shrinks its original weight fully thirty-one per cent. True, this loss arises partly from the evaporation of water, as well as the melting down and escape of fat and the destructive action of heat; yet whatever loss is occasioned has no counterpart in milk.

The whole system of milk producing and consuming works injustice, both to the well-intentioned farmer and to the city consumer, who wants first-class milk, and is willing to pay for it. The producer does not receive the cost of a good article, neither does the consumer get what he bargains for. Breed of cattle, nature of the food, care and cleanliness in handling are all-important factors in determining the value of a quart of milk; yet how many city and village people know even the county in which their milk supply is produced, much less any of the important details of its production. On the other hand, how many farmers who take a pride in producing a first-class article are ever rewarded by one cent extra or even a word of encouragement, as their milk goes to market mixed with that of less thrifty or less conscientious neighbors?

Apathy seems to prevail among the city people regarding the important article of milk. While they are particular to know where their butter is made, what brand of flour they consume, the special variety of pickles, preserves or canned fruit for the table, yet little is known as to what quality of milk they use, and yet the latter enters into the composition of every meal their families consume. To obtain the milk in good condition, a proper and sufficient diet must be supplied, and as far as yet discovered in the care of the cow, no summer food can be considered equal to that which is yielded by the fresh pasture of country fields, the plants of which give a richness, sweetness and agreeable aroma, which cannot be supplied by any other mode of feeding. The milk of cows fed on distillery wash, coarse herbage and inferior food cannot be compared in quality with the product of such cows as receive liberal supplies of grain, roots and good English hay.

When the public sentiment of our cities and large towns is sufficiently aroused, first to understand the value and importance of milk as an article of diet, especially for the young, and next to know and appreciate the wide difference between good and poor, or between milk as drawn from the cow and ordinary city milkman's milk, that has been subjected to the skimming process, even if nothing worse has befallen it, then consumers of milk will demand a more intimate acquaintance with the producers and their method of production: a more direct connection with the farmers themselves. Then will superior milk command a higher price than the poorer article; then will the army of useless middlemen have an opportunity to retire, and the milk business of our large cities be conducted by the associated efforts of those who produce the milk, and those alone who are entitled to the profit of this important branch of farm economy.—*Boston Cultivator.*

CHEMICAL SOCIETY, LONDON, NOVEMBER.

DR. GLADSTONE, PRESIDENT, IN THE CHAIR.

a—"*On Some Hydrocarbons Obtained from the Homologues of Cinnamic Acid*," and *b*—"*On Anethol and its Homologues.*"

By W. H. PERKIN, F.R.S.

a.—Considerable quantities of cinnenyl-arcylic, crotonic and angelic, and phenyl-crotonic and angelic acids were prepared. The hydrocarbons were at first obtained by decomposing the acids by heat; afterwards the process proposed by F. Binder—viz., treating the hydrobromo acids with bases—was found to yield more satisfactory results. A solution of hydrobromic acid in glacial acetic acid, instead of an aqueous solution, answered very well. The following acids were prepared and examined: Hydrobromocinnenylacrylic acid $C_{12}H_{13}BrO_2$, fuses 85 deg. to 87 C. Hydrobromocinnenyl-crotonic acid $C_{13}H_{17}BrO_2$ crystallizes in flat, oblique prisms, fuses at 148–150 deg. C. On further heating, HBr is evolved. Hydrobromocinnenyl-angelic acid $C_{14}H_{19}BrO_2$. All these hydrobromo acids, when treated with a cold solution of sodium carbonate or potassium hydrate, decompose, hydrocarbons being produced as follows: Isopropylvinyl benzene boils at 203–206 deg. C., sp. gr. at 15 deg. ·8902. Heated for a few hour to 150 deg. C., it solidifies to a transparent glassy mass. This change also takes place slowly at ordinary temperatures in daylight. The properties and chemical reactions of this substance are given. The dibromide was prepared, fusing at 71 deg. Isopropylallyl-benzene boils at 229 deg. to 230 deg., sp. gr. 15·890; does not solidify at 15 deg. C. Its formation may be represented thus:—

$$C_6H_4(C_3H_7)CH{:}CH{\cdot}OH{\cdot}COOH = C_6H_4(C_3H_7)CH{:}CHCH_3 + CO_2$$

Cinnenyl-crotonic acid — Isopropylallyl-benzene;

or, $C_6H_4(C_3H_7){\cdot}CH_2CHBr{\cdot}CH_2COOH = C_6H_4(C_3H_7)CH{:}CHCH_3 + HBr + CO_2$

Hydrobromocinnenyl-crotonic acid

Its dibromide was obtained by shaking the hydrocarbon with bromine. It melts at 59 deg. to a colorless oil, crystallizing beautifully on cooling. Isopropylbutenyl-benzene is a colorless oil, boiling at 242–243 deg.; its sp. g. at 15 deg. is ·8875. It resinifies if kept in contact with the air. Its dibromide was prepared melting at 77 deg. Allyl-benzene boils at 174–175 deg.; sp. gr. at 15 deg. ·9180. When heated between 160–200 deg. for sixty hours, it did not undergo any visible change. Its dibromide was obtained as a crystalline mass, fusing at 67 deg. Butenyl-benzene, a colorless oil boiling at 186 to 187 deg. C.; a dibromide was prepared, crystallizing in needles melting at 57 deg. The two last named hydrocarbons have already been obtained—allyl-benzene by L. Rügheimer (*Jour. Chem. Soc.* 1974, p. 894); it has the same constitution as the body prepared by the author. The butenyl-benzene, however, prepared by B. Aronheim (Deut. Chem. Ges. Ber. v. 1068) is isomeric with the one now produced—"b." On gently boiling methyl-paroxyphenyl-acrylic acid, an oil gradually distils over, having a fennel-like odor. This body, after purification, had the formula $C_9H_{10}O$, the author proposes to call it vinylic anethol; it boils about 201 to 202 deg.; melts at about 1 to 2 deg. Its formation may be represented thus:—

$$C_6H_4(OCH_3).CH{:}CH.COOH = C_6H_4(OCH_3).CH{:}CH_2 + CO_2$$

An endeavor was made to prepare this substance by Binder's reaction, but without success. On heating methyl-paroxyphenyl-crotonic acid, an oil distils over, carbonic acid being evolved; by fractional distillation, freezing, and pressing the mass thus obtained between blotting paper, perfectly pure allylic or ordinary anethol was obtained, identical with that obtained from oil of anise. By heating methyl-paroxyphenyl-angelic acid, butenylic anethol is obtained in an impure state; but by treating the hydrobromo derivative of that acid with sodium carbonate, etc., perfectly pure butenylic anethol is obtained; it is crystalline, fusing at 17 deg. C., boiling at 242 to 245 deg.; sp. gr. at 30 deg. ·9733; formula, $C_{11}H_{14}O$. In conclusion, the author discusses the formation of the hydrocarbons from the hydrobromo acids by heating with sodium carbonate; he finds that silver nitrate in aqueous solution, sodium acetate, and in some cases even water, may be substituted for sodium carbonate, and yet the hydrocarbon be formed, and concludes that the hydrocarbons are formed simply by the separation of hydrobromic acid and carbonic anhydride. The author remarks that only the hydrocarbons and anethol containing vinyl polimerise when heated, and form compounds corresponding to metacinnamene; also their boiling points differ much more from those of the compounds containing allyl than do the latter from those of the butenyl compounds.

Dr. Gladstone said that the Society had rarely listened to a research so productive of new and interesting substances, and pointed out the interesting results which would probably be obtained by an examination of the refraction and dispersion of these new bodies.

"*On Two New Methods for Estimating Bismuth Volumetrically*," by M. M. Muir.—Chancel has shown (Jahrber. 1860, 612) that bismuth is precipitated in the form of phosphate by the addition of a soluble phosphate to solution of the metal in nitric acid. Both processes are based on this fact. In the first bismuth is thrown down from nitric acid solution after partial neutralization with ammonia, by addition of a standard solution of sodium phosphate; the final point of the reaction is determined by spotting the supernatant liquid on a slab with warm ammonium molybate solution. The results are approximately accurate. In the second process the nitric acid solution of bismuth is mixed with an excess of sodium acetate, a measured volume—excess—of standardized sodium phosphate is added, the liquid boiled and filtered, the precipitate is well washed with hot water, and the excess of phosphoric acid determined in the filtrate by titration with a standard solution of uranium acetate. The results are very accurate. This second method is much to be preferred to the first, and it is much more satisfactory than the author's dichromate process (*Chemical Society's Journal* I., 1876, 483).

"*On the Oxidation of Ditolyl*," by T. Carnelly, D. Sc.—Last year in the production of tolyl phenyl, the author obtained a quantity of liquid and solid ditolyl as a by-product; by fractionating, solid ditolyl melting at 121 deg. C. and two liquid ditolyls boiling about 275 and 285 deg. were obtained. These substances were oxidized with chromic and glacial acetic acid; solid ditolyl gave, on oxidation, (1) dipara-tolyl-phenyl carbonic acid

$C_{12}H_{10}\begin{cases}CH_3\\CO.OH\end{cases}$ as a white powder melting with blackening at 244 deg.; and (2)

$C_{12}H_{10}\begin{cases}CO.OH\\CO.OH\end{cases}$ dipara-diphenyl-dicarbonic acid.

These two liquid ditolyls gave identical results on oxidation; (1) ortho-para-tolyl-phenyl-carbonic acid

$C_{12}H_{10}\begin{cases}CH_3\\CO\ OH\end{cases}$ a white powder melting at 176 deg. C.;

and (2) orthopara-diphenyl-carbonid acid $C_{12}H_{10}\begin{cases}CO\ OH\\CO\ OH\end{cases}$ a white powder which sublimes before fuming, and finally terephthallic acid. The above experiments show that when sodium acts on a mixture of para and ortho-brom toluene two isomeric ditolyls are produced, and dipara and the ortho-para compounds. The author gives graphic formulæ showing the constitutional relations of the above bodies, and concludes by stating that he hopes to be able to prepare the diorthoditolyl, from it obtain, by oxidation, diphenic acid, and thus confirm the constitution of phenanthrene. "Note 1."

"*On a New Manganese Reaction*," by J. B. Hannay.—When a solution of a manganous salt in strong nitric acid is warmed with the addition of crystals of potassic chlorate, the whole of the manganese is precipitated as manganous manganate. If a salt of iron be present, a double manganate of iron and manganese, $2\,Fe_2(MnO_4)_2.\,Mn\,O.\,Mn\,O_2\,12\,H_2O$, is precipitated; no other metals seem to be precipitated with manganese under the same conditions. The precipitate is insoluble in nitric and sulphuric acids, and unattacked by caustic alkalies. Hydrochloric acid acts on it, and reducing agents rapidly decompose. Sulphurous acid first attacks the iron, setting free manganese dioxide, which rapidly collects into little nodules, having a considerable degree of coherence. The manganese slowly disappears, the final reaction being

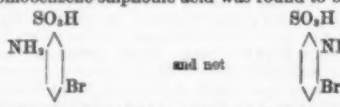
$$Fe_2(Mn\,O_4)_2 + 6.SO_2 = Fe_2(SO_4)_3 + 3\,Mn\,SO_4.$$

The principal interest in the above reaction is that it furnishes a good method of separating iron from aluminum, etc., without the use of pure caustic soda. The iron compound appears under the microscope as thin flexible plates of a purple-brown color.

METABROMOBENZENESULPHONIC ACID.

By ALFRED THOMAS.

Pure benzencsulphonic acid was prepared and neutralized with silver carbonate, and the still warm liquid treated with bromine until no further precipitate of silver bromide was produced; the liquid was then evaporated on the water-bath, neutralized with barium carbonate, and further evaporated; crystals of barium metabromobenzenesulphonate separated, readily purified by animal charcoal; the mother-liquor contained some barium benzene-sulphonate. From the barium salt the free acid was prepared by treatment with dilute sulphuric acid; and from this *nitrometabromobenzene-sulphonicacid* was obtained by the action of nitric acid; the potassium and ammonium salts are anhydrous, the barium salt is $\{C_6H_3Br(NO_2)(SO_3)\}_2Ba.3H_2O$: the calcium salt contains $6H_2O$, the lead salt crystalizes with $3H_2O$, and the silver salt has $1\frac{1}{2}H_2O$. The chloride of this acid melts at 83°, after crystallization from ether. By the action of ammonium sulphide this acid forms *amidometabromobenzene sulphonic acid*, of which the potassium salt is anhydrous, whilst the barium salt crystallizes with $1\frac{1}{2}H_2O$, and the lead salt with $2H_2O$. By treating this acid with hydriodic acid and amorphous phosphorus at 110°, the bromine is removed, and an *amidobenzenesulphonic acid* formed; from the solubility of this substance it was recognized as the *ortho* acid, whence the nitro-acid is *orthonitrometabromobenzene-sulphonic acid*; moreover, the relative positions of the lateral chains in orthoamidometabromobenzene-sulphonic acid was found to be:—



from the circumstance that on conversion into the diazo-derivatives and treatment with hydrobromic acid, *paradibromobenzene-sulphonic acid* resulted (where the two Br groups are para with respect to one another, one being meta and one ortho with reference to the sulphonyl-group). The potassium salt of this dibrominated acid crystallizes with $1H_2O$, whilst the barium salt forms needles containing $1\frac{1}{2}H_2O$, and prisms with $5H_2O$.

When orthonitrometabromobenzene-sulphonic acid is heated to 160° with alcoholic ammonia, the bromine is removed and amidogen substituted for it, forming *orthonitrometamidobenzene-sulphonic acid* the barium salt of which crystallizes with $1\frac{1}{2}H_2O$; a little of a body melting at 151—152° was formed, probably an impure *paranitrobromobenzene*, as it seemed to form parabromaniline on reduction with tin and hydrochloric acid.—*Liebig's Annalen.*

The foregoing is an example of the progress of the outlandish terms used by modern chemistry.—[Ed. S. A.]

YELLOW GLASS BETTER THAN BLUE.—According to M. Fano, neurosis of the eye has been successfully treated by the use of spectacles with yellow glasses

ABSOLUTE ELECTROMETER OF THE PHYSICAL SOCIETY, LONDON.

THE President, Prof. G. C. Foster, lately described and exhibited a very simple form of absolute electrometer, which acts on the same principle as Sir W. Thomson's trap-door form of apparatus, but can be constructed at a very moderate cost. To one arm of a balance is suspended, by silk fibres, a zinc, which hangs horizontally in the plane of a sheet of the same metal, forming a guard-plane; and at a distance of about 1 inch below is a flat sheet of zinc, also horizontal. An electrical connection is formed between the guard-plate and suspended disk by a bridge of very fine wire. The method of using the apparatus to determine the potential required for a spark to pass from a Holtz machine through varying thicknesses of air was explained. When the balance has been accurately counterpoised an excess of weight, say 1 grm., is introduced into the scale-pan, and the guard-plate and the lower attracting-plate, as well as the two knobs of a spark-measurer, are connected with the conductors of the machine. If this be now set in action, and the knobs of the spark-measurer be gradually separated, a point will be reached at which the attraction upon the suspended disk just overcomes the excess weight in the balance-pan. The length of spark for which this occurs can now be read off. The difference of the potential causing the spark is given by the formula—

$$\frac{e}{a}\sqrt{8F},$$

where a is the radius of the attracted disk, e its distance from the attracting-plate, and F the force of attraction in dynes. In the apparatus exhibited a had the value 5·195 c.m., and e the value 2·4 c.m., whence, if w be the excess weight in grammes—so that $F = 981\,w$—the difference of potential becomes $39\sqrt{w}$. The proper action of the apparatus depends essentially upon the attracted disk being accurately in the same place with the guard-plate. To facilitate this adjustment each of the silk fibres by which the disk is suspended is attracted to a screw, by which it can be separately raised or lowered; and by means of another screw the small brass plate holding the suspending screws can be raised or lowered as a whole. A few numerical results were given to illustrate the action of the apparatus: these were taken from a set of experiments in which the difference of potential needed to produce sparks in air between two equal brass spheres of 2·61 c.m. radius was measured. The following are the results of a few of the shortest and longest sparks measured:

Length of Sparks.	Difference of Potential.	Mean Electrical Force.
0·1325 c.m.	17·4	131·0
0·1825 "	20·4	117·0
0·2370 "	24·6	104·0
. .	. .	. .
. .	. .	. .
0·6800 "	62·9	93·0
0·7100 "	65·2	92·0
0·740 "	68·7	93·0

LITHIUM, CÆSIUM, AND RUBIDIUM.

Lepidolite contains very considerable quantities of alumina, which the author proposes to utilise. Its composition is:

Alumina	28.54
Silica	50.39
Ferric oxide	0.73
Alkaline earths	1.52
Alkalies	16.00
Water	2 to 3

The mineral is melted in a reverbatory, suddenly chilled, and pulverized. It is then treated with an equal weight of monohydrated sulphuric acid in a vat lined with lead, and heated with a current of steam. The paste produced is then drawn off before it solidifies, and allowed to stand for twenty-four hours. An excess of water is then added, and the whole is then boiled, and filtered at a boil in a leaden filter-press, or else allowed to settle and decanted without growing cold. The liquid is concentrated to 40° B. in leaden boilers heated by steam, and is then allowed to crystallize. On cooling all the rubidium and the cæsium are deposited as an alum along with a very little potassium. The alums of cæsium and rubidium are separated by a series of crystallizations. The mother-liquors containing the potash alum and an excess of sulphate of alumina and free sulphuric acid are mixed with a cold concentrated solution of carbonate of potash (25 parts of dry carbonate to 100 of chilled lepidolite). The alum is deposited on cooling as a crystalline powder containing mere traces of iron. The mother-liquors of the alum, still acid, are diluted with water, treated with an excess of carbonate of potash to throw down the alumina, filtered and evaporated to 35° B. Sulphate of potash and a portion of sulphate of soda crystallise out on cooling. The mother-liquors are again digested with powdered carbonate of soda to precipitate lithia. The small quantities of this base still remaining in solution are precipitated with phosphate of soda. The lithic phosphate thus obtained is melted with lime, and the lithia thus liberated is extracted in boiling water. The crude carbonate of lithia precipitated is re-dissolved in boiling water, and causticised with lime. The clear solution, concentrated to 40° B., is then treated with pure carbonate of soda. Carbonate of lithia is then precipitated in a state of purity, and is washed with a little water, then with alcohol, and finally dried.—*Dingl. Pol. Journ.*

EXPERIMENTS ON PRODUCTION OF PLANTS.

PROF. H. HOFFMANN has been for twenty-two years engaged in experiments on the modification of plants by interference in their external vital conditions. He concludes that the cause of the evolution of new species lies, not, as Darwin believes, in outward influences, but in internal organic laws, whose nature is at present concealed.

THE HONEY TRADE.

By ANDREW J. LAWSON.

THE honey trade is a very quiet one, yet there is a good deal of buzz about it. The production of honey has occupied comparatively little attention on the part of the statisticians of the country, who have made a study of the production of the United States a specialty. But it is ascertained that over 150,000 persons in this country are engaged in the keeping of bees. This includes farmers and others, who make the production of honey a part of their occupation; and it is also estimated that these persons have twenty-five apiaries each, a full swarm being estimated at about 20,000 bees. This will give a total of 75,000,000 bees employed in the production of honey for commercial purposes.

Twenty years ago, when the movable-comb system was introduced, those who adopted it thought they had reached perfection. At that time the yield of honey from a single hive of bees did not exceed fifty pounds; now, as we have already intimated, large apiaries have been made to yield several hundred pounds of honey per annum from single hives, while individual colonies have been known to produce from 500 to 700 pounds. At a meeting of the North-American Bee-Keepers' Society, held some years ago, one member offered to sell a large number of hives, to be paid for only on condition that he should, in the following year, take ten colonies, containing a quart of bees each, and from them secure 10,000 pounds of honey, or at the rate of 1,000 pounds per hive. A writer on the subject of bee culture asserts that bees do not possess reasoning powers, notwithstanding the contrary assertion of many eminent naturalists. They are governed by immutable laws, from which it is impossible for them to swerve or deviate. The fact that there is a "business end" to the bee would seem to justify this conclusion, as many a youth has discovered who had the temerity to bother the bee when it was attending to its work. It was not our intention to discuss the structure, habits, etc., of the bees in this gossip, nor the general cause of the production of drones and queens, of the parthenogenesis and organic production of bees, but only to refer to the commercial importance of the insect.

Taking the low estimates of fifty pounds of honey to each swarm, it will give a gross production of honey for the market of about 3,750,000 pounds. Allowing that it is necessary to leave about forty pounds of honey in each hive, for the use of the bees in the winter, the gross product of the "little busy bees" of the United States cannot be less than 7,000,000 pounds yearly, that which is sold in the market being classed as "surplus honey." The census of 1870 gives the amount of bees' honey produced in the United States in that year as 14,702,000 pounds, against 23,000,000 pounds produced in 1860, and 14,800,000 produced in 1850. It will be seen from these figures that there has been considerable variation in the production of the article during the past twenty-five years; and the estimate which we have made respecting the production of honey in 1876 is based upon recent carefully collected statistics, which seem to be radically different from those of the census, indicating, as they do, that there has been a material falling off in the production of honey during the past ten years, leaving out the quantity necessary to leave in the hive for winter use.

Next to California, which ranks first, on account of its genial climate and the little care necessary for the protection of bees in the winter, comes the State of New York in the amount of production, and North Carolina next, which produced in 1870 over 1,400,000 pounds. Mississippi raises nearly as much as North Carolina; then Missouri, followed by Kentucky and Illinois. New York claims to practise better plans for the preservation of bees throughout the winter than any of the Northern or Western States. Wisconsin, which in 1870 produced 300,000 pounds, has now doubled its quantity. This is owing in part to the bass-wood forests, for bees are well known to be rovers, and gather the honey wherever it can be found the best. Most of the Western States, however, consume almost as much honey as they produce. An incident of Wisconsin production is given, as showing what may be done in bee culture. Adam Grimm, a German, who emigrated to Wisconsin a poor man, devoted himself to the cultivation of bees and the production of honey. He settled at Jefferson in that State, and at the time of his death he possessed no less than 1,400 swarms, and his estate was valued at $100,000 which he made entirely from his bees. He was in the habit of saying that the production of honey at five cents per pound paid the farmer better than the cultivation of hay, and was a far more agreeable occupation. The last year that he was in business he produced 22,725 pounds, selling at the average of nineteen cents per pound, all expenses deducted. Mr. Grimm wintered his bees in cellars, and lost not above 1½ per cent. In the same year our farmer readers may remember there was a great loss of bees in Iowa; at least two-fifths of the whole number in the State died. But an investigation of the subject showed that the loss of the bees was attributed more to the condition in which the severe cold weather found the stocks, than to the extreme and prolonged cold winter. A hint may be taken from this statement by those of *The Cultivator* readers who possess apiaries.

Respecting the production of honey in the several States, it may be stated incidentally that 100,000 pounds of the article are shipped annually from the stations of Herkimer, Little Falls, Saint Johnsville and Canajoharie, in New York State. This is generally gathered from an area of about 400 square miles, and is not more than one-tenth the amount which might be produced in that region. At this rate 5,000,000 pounds might be made in the State, which, at twenty cents per pound, would amount to $1,000,000. Again, the experience of Mr. Doolittle of Borodino, New York State, shows how low the average estimate, given in the first part of our article, must necessarily be. One of his swarms is reported to have produced in one year 566 pounds of honey, although this he regarded as somewhat remarkable. During the past five years Mr. Doolittle cleared by his bees $6,000 after paying all expenses, and with only six acres of land. This gentleman, we are told, makes bee-culture a special study. From July 21 to July 24 he made sixty-six pounds of honey from one hive, or an average of twenty-two pounds per day.

Honey production pays. One house alone, in New York city, regularly every year buys a part of San Diego, Cal., crop, paying for the same the sum of $18,000, and a Boston firm, buying for the same party, pays $8,000, annually, for honey. Yet there are farmers who say, "there is no money in bee-culture." If farmers exercised a little more business tact, and sent their honey to market in good shape, they would have no occasion to complain. Those who have stuck to the honey business have got rich, and there is a disposition in not a few localities, especially in California, among the bee culturists, to "monopolize" the calling.

There are now half a dozen monthly journals, published in this country, exclusively devoted to the management of bees, showing an extraordinary interest in this subject within a few years. Aside from the value of the bee as a producer of honey, the insect unwittingly assists the farmer or fruit-raiser in raising a good crop. Gardeners, too, have always known that bees fertilize squash, melon and cucumber flowers, by conveying the pollen from one plant to another. A careful and observant bee-keeper writes that his trees yield decidedly larger crops since he has established an apiary in his orchard, and the annual crop is now more certain and regular than before, though his trees had always received due attention.

The value of honey at the present time, in this market, is from twenty-two to twenty-five cents per pound for the finest, and about fifteen cents per pound for buckwheat honey. At retail a two-pound box of the article costs about eighty cents, or forty cents per pound in the comb. There is considerable of the adulterated article in the market, put up in bottles or jars, which sells at about the same rate as the pure article. The trade in honey, and honey in the comb, is confined to a comparatively few firms.—*Boston Cultivator.*

THE "DEVIL BEANS" OF MEXICO.

[By J. W. A. WRIGHT.]

Among the many odd forms of insect life, none are more curious than the gall insects. Like all winged insects, they pass through the four stages of (1) the egg, (2) the larva or maggot, or grub, or worm, (3) the pupa, or cocoon, or chrysalis, (4) the perfect or winged state.

What especially distinguishes them from other insects is that, in the larva or worm state, they are found enclosed in cells of very various forms and colors, which grow abnormally on different kinds of plants—including trees, shrubs and herbs. Oaks, hickories, cottonwoods, willows, sumacs, azaleas, rose-bushes, the golden rod and other herbs, and even grasses, abound with them. An odd feature marking all of them, and illustrating the great maxim—"like causes produce like effects"—is that in some way the galls containing the larva partake unmistakably of the nature of the plant on which they grow.

These cells or galls—the homes of the various larva—grow in the spring or summer as excrescences, because of the irritation produced either by the eggs deposited under the bark by the mother-insect, or by the young grub, boring into the plant in search of its needed food and protection, guided by the promptings of instinct.

The perfect or winged insects which deposit these eggs that are in turn to pass through the larva and chrysalis state into insects like themselves, in due course of nature, are

CYNIPS SALTATORIUS AND ITS FLEA SEED.

varied in form, and belong to five of the seven groups or orders into which the true insects are now divided. Some of them are: 1. Clear-winged flies (*hymenopetra*), shaped like wasps and bees. Members of this group form our common oak balls, and the nutgalls of Asia Minor, such a necessary ingredient in making ink, and the celebrated Dead Sea apples, or apples of Sodom, found on the scrub oaks of southern Syria; also the pretty colored rose-galls, covered with prickles, and the noted joint worm, which often seriously damages our growing wheat, rye and barley. 2. Two-winged flies (*diptera*), shaped like mosquitoes, gnats and house flies. They form galls on willows like pine cones; apple galls and filbert galls, on grape vine; trumpet galls on grape leaves, and tube galls on dogwood. The Hessian fly, so destructive to grain, is among these. 3. Bugs proper (*hemiptera*), like plant lice. Some of this group make the green, shining galls, and the rose-colored swellings on cottonwood trees, and the hollow, reddish galls on sumac leaves. This class includes the *phylloxera*, both the species which forms at least 16 different kinds of galls on hickory trees alone, and that notorious and dreaded species which has played such havoc in the vineyards of France and so alarmed the vine growers of California for a year or two past. 4. Beetles (*coleoptera*), consisting of a kind of weevil, which by its punctures and deposit of eggs causes swellings in grapevines and raspberry stems. 5. Scaly-wing insects (*lepidoptera*) or moths. There are fewer species of this group than in either of the first four mentioned. Their larva form swellings in the stems of the golden-rod, false indigo and perhaps other herbaceous plants.

Fig. 1. Fig. 2. Fig. 3.

Fig. 4. Fig. 5. Fig. 6.

Fig. 7.

DEVIL BEANS AND INSECT.

Then besides these five groups, there gall mites (*acarina*) which belong to the spider family, as they have generally eight legs, rather than to true insects which have but six legs, Yet they come pretty near the dividing line of true insects, as some of them have six legs. These little mites form purse-like galls on leaves of the wild plum and wild cherry.

This epitome of established facts in the interesting study of entomology or "bug-ology," whichever your readers choose to call it, is given for the better understanding of the accompanying description and engravings of the so-called

DEVIL BEANS,

or jumping beans, found in western Mexico among the mountains a hundred miles or so inland from Mazatlan, Acapulco, and other coast towns, and frequently brought to San Francisco as curiosities by the Panama steamers.

Before fuller description, and for the better understanding of your readers, let me recall the description and engraving of the queer little "flea seed," given in both the *Scientific* and *Rural Press* of February 14th, 1874. No doubt many of your readers keep files of your instructive papers—as it would well repay all to do. But, for the benefit of those who do not, the engravings are here reproduced, that difference between the "flea seed" of California and the "jumping beans" of Mexico may be more clearly seen.

As shown by Mr. Kinne, these minute galls, about the size of mustard or alfalfa seed, are found by the puncture and deposit of eggs on the underside of leaves of the California white oak by the insect here represented, *Cynips saltatorius*—engraving 20 times the different size. As will be at once seen, this insect belongs the first group above described.

The odd quality of their small seed-like galls is that they hop or bound about at a wonderful rate when warmed by the sun, or hand, or artificial heat: such motion being caused by the contraction, sudden straightening, and concussion against the sides of its shell, by the minute larva or worm inclosed in each, its antics being not unlike those of a "skipper."

We are now ready for the description of the curious jumping beans, with the insect which causes their odd movements, and the very accurate engraving in seven figures of natural size—prepared by your artists from nature especially for your columns, and the first, perhaps, ever made.

For the beans used by the draughtsman and engraver, we are indebted to Mr. W. H. Richards and Mr. H. D. Pearce, of San Francisco. The engravings of the perfect insect, or moth, which is the original cause of the motions, and its chrysalis shell, are made from a specimen hatched out at the gold pen maker's shop of the latter gentleman on the corner of Montgomery and Merchant streets, where samples of the beans may be seen.

Fig. 1 represents the three so-called beans as they grow together on a small bush in the Mexican mountains, which is said to be somewhat like our hazel bush in size. Unfortunately, no one here, so far as we know, has been able to get specimens of the bush, so that it may be identified; but steps have been taken by which we may hope to obtain it. Hence, its exact nature botanically is not known; but because of the form of this supposed seed-pod, it has been conjectured that it belongs to the order *Euphorbiaceae*, which includes the spurge, palma-christi, cassava, the box-tree (*buxus*), the Queen's delight (*stillingia*), caoutchouc plant (*siphonia*), and the crotons, both the species producing the noted irritating oil, and that from which cascarilla bark is obtained.

Fig. 2 shows how the three exactly similar parts or pods separate, while Fig. 3 is the single bean in the form in which it is usually seen, when placed on one end. It generally rests, however, on its round surface, or on one of the two flat faces, where the beans were joined. The white spot in Fig. 3 is a thin film, like the eye of a bean. If it is removed by the point or a knife, a thin white web is spun over the opening in a short time by the little yellowish maggot or larva, Fig. 4, which is very much like the worm frequently found in chestnuts. This is the little occupant that gives, by his jerks and thumps against the sides of his home, the jumping power in which the truly wonderful feature of these beans consist. Each bean is very light, averaging in weight about two grains, and hence is easily moved by the larva. Place one or more of these beans in your hand, or near a warm stove, or under the rays of the sun or a gas jet; and though perfectly quiet before, and an entirely inanimate looking object, it will soon begin to turn from side to side; perhaps, with a sudden jump, turn completely over or stand on one end, and often, by its successive jumps, moving quite a distance. After watching the motions of this apparent seed-pod, very much like a fresh grain of coffee in color and shape, only larger and thicker, and with no semblance to any living form, you do not wonder at the name "devil-bean," given it by our Mexican neighbors, who are prone to ascribe everything queer in nature, which they cannot understand, to the agency of his Satanic Majesty.

Keep one of these greenish, coffee-like beans in a moderately warm place, and, before a great while, the larva will have gone through its allotted changes; the perfect insect, a moth or fly, little more than three eighths of an inch long, with light-brown, satiny wings, of uniform color and brown hairy body, without any stripes or spots, will cut out at one end of his shell a small round piece, as nicely as if with a tiny saw, and crawl out enveloped in his chrysalis skin or sack, Fig. 5, which he soon leaves near the empty pod which has so long been his home. Its appearance then, in a somewhat dormant state, is very accurately shown in Fig. 6. An excellent likeness of this moth is given, with wings extended, in Fig. 7—perhaps a very little larger than its natural size.

Now, as regards the relationship of the work of this moth to that of gall-insects.

As is seen above, there are moths among the gall-insects. It has been conjectured that the insect whose larva is found in the "jumping moths" is a gall-moth. Really, we have not as yet sufficient data to decide with perfect certainty whether it is or not. To be a gall insect, the whole pod in which the insect is found would have to be caused by the juncture and deposit of the egg.

The strong probability is, however, that the so-called "beans" are the seed pod of some plant, and that the moth deposits its egg in the pod when very young—possibly even when in the flower state, as the troublesome apple moth deposits its egg in the apple flower. If so, the larva destroys the germ and cotyledons of the seed totally, leaving the mere shell. The reasons in favor of this view are; 1. The great regularity in form of the three united "beans." 2. There being no perceptible mark on the thin hull of the "beans" of any puncture of an ovipositor.

These and similar points are yet open to investigations, which are being made. It is a pleasure to state that Mr. Harry Edwards, so well known in connection with the California theater, and one of the best posted naturalists of this coast, is thoroughly investigating the matter, being in correspondence with the manager of the British Museum, London, and will soon give us a report, which will be looked for with much interest.

The devil-bean moth clearly belongs to the group of *Lepidoptera*, or *scaly-wing insects*. Mr. Edwards thinks it is certainly among the *Tortricidæ*, or family of leaf-rollers. Several of this family, like the apple worm, or codling moth (*Carpocapsa pomonella*), described in the *Rural* of October 27th, instead of rolling their eggs and larva in leaves, deposit them in the young fruit of the plants to which they are partial, and are hence called bud-moths. Mr. Edwards thinks it quite likely this moth is a new species. On this and other interesting points he hopes soon to give us more information than is at present possessed.—*Mining and Scientific Press.*

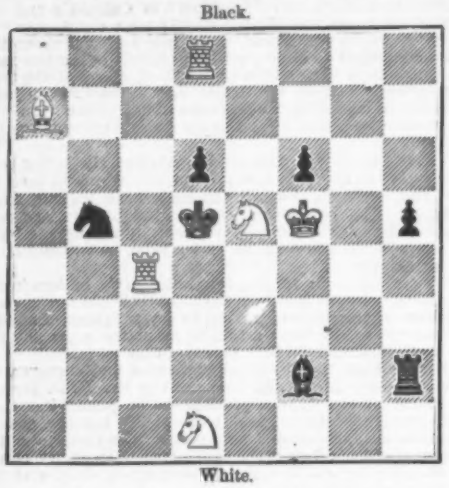
SCIENTIFIC AMERICAN CHESS RECORD.

[All contributions intended for this department, may be addressed to SAMUEL LOYD, Elizabeth, N. J.]

PROBLEM No. 44. BY BEN. S. WASH.

Second Prize.—Hartford *Globe* Tourney.

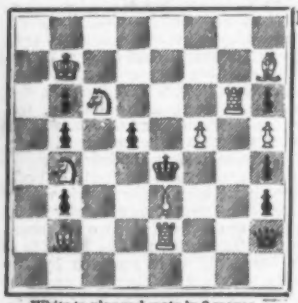
Black.



White.

White to play and mate in two moves.

BEN. S. WASH, OF ST. LOUIS.



White to play and mate in 3 moves.
By DR. C. C. MOORE.

MR. WASH, whose portrait we give this week is favorably known as a rising young amateur, who has already won his spurs by carrying off the honors of the recent Hartford *Globe* Problem Tourney, in which contest, as has been previously recorded, he received the prize for the best problem of the tournament, and for the second best set of two problems. Although he has but recently made his debut, he is already looked upon as a prolific and talented problemist, in whose compositions we find the true sparkle of genius that gives promise of a high niche in the temple of fame. His positions are pleasing and graceful, belonging to the new school which we predict will be the problems of the future, to supersede the present chaotic style, with tangled variations and nothing but abstract difficulty to recommend them, that awe the minds of the antiquarian critics who dare not pronounce in favor of a superior idea treated with but few pieces.

We reply to a score of correspondents, and make a somewhat necessary explanation by remarking, *en passant*, that our brief biographical sketches treat only of what relates to chess, and it would be idle and irrelevant to mention which of our chess magnates were born of rich but honest parents, or the profession they follow; it is pertinent to the occasion, however, to remark that Mr. Wash is a rising young lawyer of St. Louis, who is bound to succeed in whatever he undertakes, because he has shown that he possesses extraordinary talent, and is one of the few we have ever known who had the nerve to withdraw from chess play, and even resign his important position as editor of the spicy chess department of the *Globe Democrat*, *because it interfered with his business hours*. We could moralize at considerable length upon this subject, and show that it would be greatly to the advantage of "the cause of chess" if our players only allowed this intellectual pastime to encroach upon their idle moments.

NEW YORK CHESS CLUB TOURNEY, 1861.

HAVING taken part in this tournament, we are pleased to correct a statement made by one of our exchanges, and give a correct record of this pleasant little contest, which was inaugurated for the purpose of testing the skill of Mr. Leonard, who was at that time looked upon as one of our most promising young players.

There were eight participants, viz.: Perine, Barnett, Loyd, Schultz, Marache, Horner, Thompson, Leonard, who contested for a beautiful set of chess men, offered by the club. Both Mr. Leonard and ourself fought our way to the last round without losing a game; we each then scored one game, after which Leonard won the match by the following odd little game.

S. LOYD.	J. H. LEONARD.
WHITE.	BLACK.
1. P to K 4	1. P to K 4
2. Kt to K B 3	2. Kt to Q B 3
3. B to Q Kt 5	3. P to Q R 3
4. B to R 4	4. Kt to K B 3
5. Q to K 2	5. B to B 4
6. B x Kt	6. Q P x B
7. Kt x K P	7. Q to Q 5
8. Kt to Q 3	8. B to Kt 3
9. P to K 5	9. Kt to Q 4
10. P to Q B 3	10. Q to K R 5
11. Q to K B 3	11. Castles.
12. Castles.	12. B to K Kt 5
13. Q to K 4	13. Q R to K sq
14. P to K R 3	14. P to K B 4
15. Q to Q B 4	15. K to R sq
16. P x B	16. P x P
17. Q to K 4	17. R to R 3
18. P to K Kt 3	18. Q x P ch
19. Q to Kt 2	19. Q x Kt, and white resigns the game.

LINCOLN COUNTY CHESS ASSOCIATION.

A GRAND chess gathering in connection with this association will be held in the Guildhall at Grantham, under the patronage of H. R. H. Prince Leopold, commencing on Monday, Dec. 31. The president of the association is the Earl of Brownlow. Prizes will be offered in various tournaments, the players to be divided in classes according to their strength. For the tourney of class 1 three prizes are offered, the first prize of £15, including a cup, given by H.R.H., Prince Leopold. The competition is, however, not open to any players who have carried off the chief honors at the meetings in London of the British Chess Association, or at other important metropolitan meetings. In class 2 amateurs will compete who are not strong enough for class 1; the first prize will be £7, other prizes according to the number of entries. Sand glasses, and a time limit of twenty moves per hour, will be compulsory in class 1, and optional in class 2. Amongst the other tourneys deserves to be mentioned one in which the pieces are to be displaced at starting, and for which a prize of the value of £5 5s. is offered by the Rev. J. Greene. The competition in this tourney will be open to all those who are eligible to compete for the chief prize in class 1, and will take place on Monday, Jan. 7. The vexed question of providing against all the games not being finished is, we believe, settled for the first time in a satisfactory manner by the imposition of a deposit on competitors, which is to be forfeited in case of default in playing the full number of games.—*London Field.*

THE ALBION PROBLEM TOURNAMENT OF '56.

WE give this week the problem that received the prize of a beautiful set of chess men and board of the value of fifty dollars, offered by Mr. Perine for the best problem in three moves, contributed to the *Albion* during the year 1856. Mr. E. B. Cook, acting as umpire. This problem was one of our early compositions, and although quite an impromptu affair, we do not feel that we have improved on it much during the quarter of a century that has elapsed since its composition.

Yours Truly
Sam'l Loyd

STEINITZ AND DEVERE, 1865.

AT the close of the year 1865, a match was arranged for a suitable prize, under the auspices of the London Chess Club, to test the relative strength of Steinitz and DeVere, Steinitz was to render pawn and move to DeVere, the winner of the first seven games to be declared the winner, twenty-four moves to be made every two hours. The result of the match, DeVere 7, Steinitz 3, drawn 3, proved conclusively that De Vere was entitled to take rank among the foremost players of Europe. The following is the concluding game of the match.

DEVERE.	STEINITZ.
(Remove black's K B pawn.)	
WHITE.	BLACK.
1. P to K 4	1. P to Q 3
2. P to Q 4	2. Kt to K B 3
3. Kt to Q B 3	3. P to K 3
4. Kt to K B 3	4. Kt to Q B 3
5. B to Q Kt 5	5. P to Q R 3
6. B x Kt ch	6. P x B
7. Castles	7. B to K 2
8. Q to Q 3	8. Castles
9. Q Kt to K 2	9. P to Q R 4
10. Kt to K Kt 3	10. B to R 3
11. P to Q B 4	11. P to Q 4
12. P to Q Kt 3	12. P to Q B 4
13. K P x P	13. K P x P
14. Q to K 3	14. Q P x P
15. Kt to K B 5	15. R to K B 2
16. R to K sq	16. Kt to Q 4
17. Q to K 6	17. B to B 3
18. Kt to K 5	18. B x Kt
19. R x B	19. Kt to Q Kt 5
20. Kt to K R 6 ch	20. P x Kt
21. B x P	21. Q to K B 3
22. R to K Kt 5 ch	22. Q x R

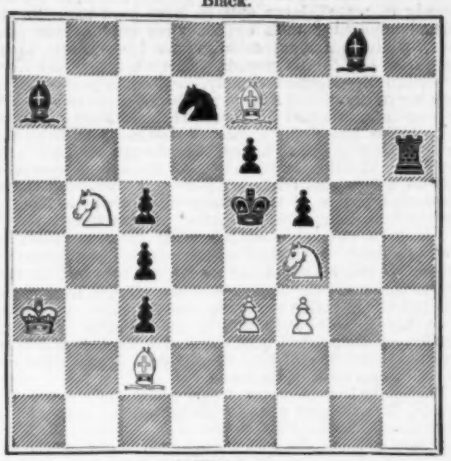
23. B x Q, and after a few more moves black resigned the game and the match.

At the time of his death, which occurred a couple of years ago, Mr. DeVere was recognized as the strongest English player, and his premature death is the more to be regretted, as he was unquestionably not yet in his prime. Staunton and others have predicted that he would ultimately become the leading player of Europe.

PROBLEM No. 45. BY SAMUEL LOYD.

First Prize.—*Albion* Tourney.

Black.



White.

White to play and mate in three moves.

SOLUTIONS TO PROBLEMS.

No. 37.—BY CONRAD BAYER.

WHITE.	BLACK.
1. Kt to K Kt 3	1. B to Kt 4
2. K to R 5	2. B to Q sq
3. Q to K B 4 ch	3. K x Q
4. B to Q 6 mate (a masterpiece).	

No. 38.—BY CONRAD BAYER.

WHITE.	BLACK.
1. B to K 2	1. Kt to K 3 (best)
2. R to K Kt 6	2. Kt x B
3. P to B 4 ch	3. K to Q 5
4. R to Q 6 mate (a beautiful problem).	

ENIGMA No. 1.—BY S. LOYD.

WHITE.	BLACK.
1. B to Q sq	1. R x P ch
2. K x P	2. Black must mate.

ENIGMA No. 2.—BY CONRAD BAYER.

WHITE.	BLACK.
1. Q to Q R 5	1. Kt x Q
2. P to Q 7	2. Q x P
3. R to Q 8	3. Q x R
4. Kt to Q sq	4. K x Kt
5. Kt to B 3 mate	

ENIGMA No. 3.—BY CONRAD BAYER.

WHITE.	BLACK.
1. Kt to Q 6	1. P x R
2. Q to K B 4 ch	2. Kt x Q
3. B to K 3 ch	3. K x B
4. Kt to K B 5 ch	4. K moves.
5. Kt mates.	

ENIGMA No. 4.—BY CONRAD BAYER.

WHITE.	BLACK.
1. K Kt x P	1. P x P
2. Q to K 6	2. P x Q
3. Kt to Q B 5 ch	3. K to Q 5
4. Kt x P ch	4. K to Q 4
5. B to K 4 mate.	

ENIGMA No. 6.—BY CONRAD BAYER.

WHITE.	BLACK.
1. R x K P	1. P x R
2. Q to K B 5	2. K x Kt
3. P to Q 4 ch	3. P x P
4. B to B 6 ch	4. K x B
5. Q to B 8 mate.	

DEATH OF MR. RIMINGTON WILSON.

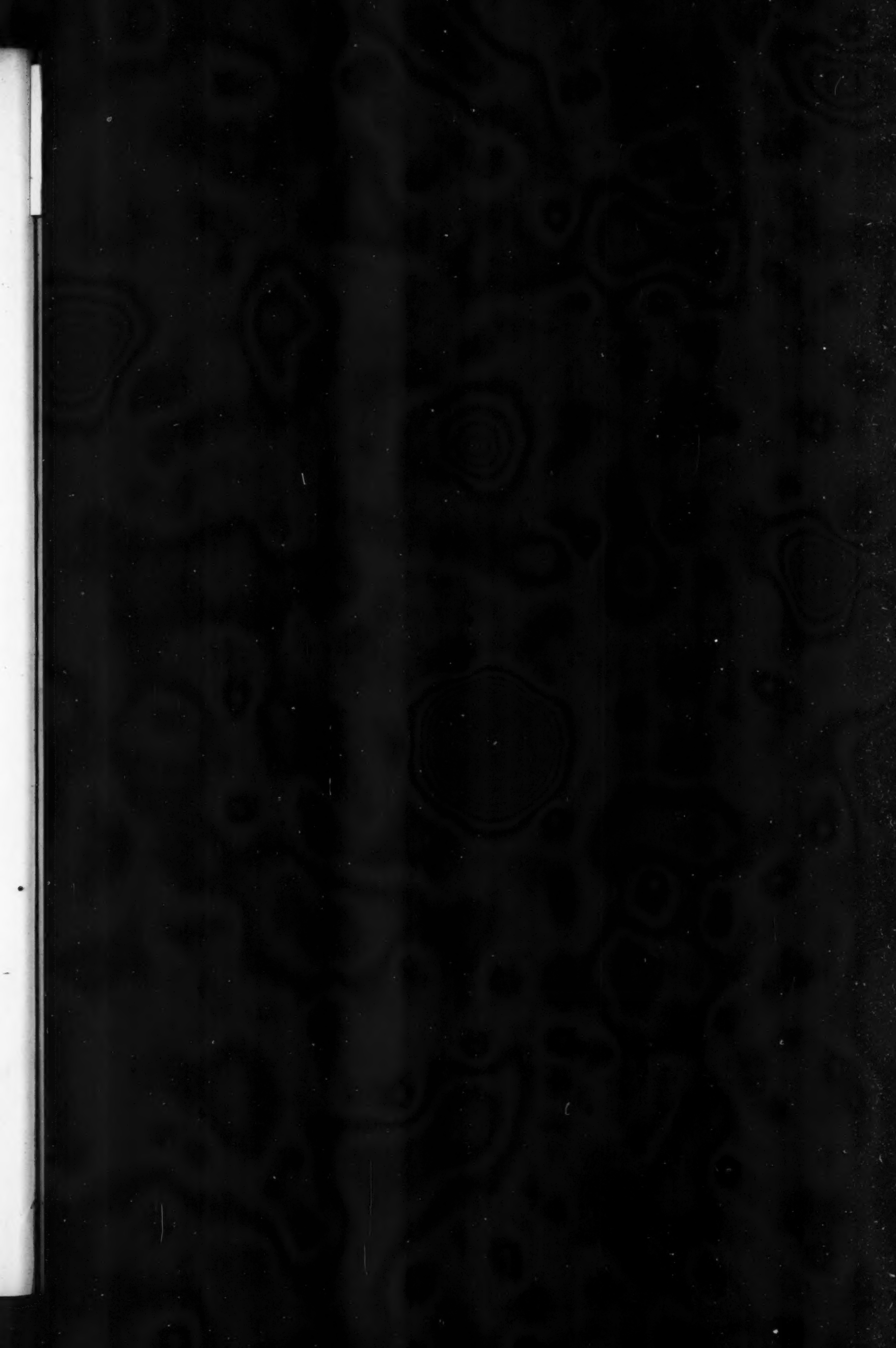
WE deeply regret to announce the death of Mr. J. W. Rimington Wilson, which occurred at his residence, Broomhead Hall, Sheffield, on the 27th ult. The deceased was a generous supporter of chess, and contributed handsomely to all the tournaments and some of the matches between first-rate players which have been arranged in this country. His splendid collection of chess works is perhaps the largest and rarest of that specialty in the world, and contains unique manuscripts of the earliest dates to which our pastime can be historically traced.

THE enterprising editor of the Hartford *Globe* enters into the spirit of the Association Problem Tourney with commendable liberality; he not only contributes ten dollars worth of chess works to the Author's prize for the most difficult problem of the tourney, but adds three prizes for the best Association problems published in the *Globe*, as follows:

1. For the best problem, a collection of twenty-five fine heliotype genre plates, after the works of acknowledged masters. These plates are of large folio size, are valued at 60 marks at the place of manufacture, and probably worth twice that amount in this country.

2. For the second best, a copy of Dr. C. C. Moore's new problem book.

3. For the third best, the Hartford *Globe* for one year.

As a further encouragement to solvers, he offers a prize for the greatest number of correct solutions to the published problems.

A prominent chess patron of this city has offered a hundred dollars as a prize for a consultation match to be played between six of the leading players of New York.